APPENDIX 9-C

Terrain Stability Assessment for the Project Footprint Study Area

Table 6.1: Red Mountain Gold Mine Access Route Section 1 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
0+000 443799 6210749 **POC** **Sec. 1-A**	**0+100** 443873 6210705	0-10%	Start the assessment at the junction of the proposed Red Mountain Gold Mine Access Road. The road junctions with Highway 37A at the Clements Lake Recreational Site turnoff. The alignment tracks an existing road which is in good condition aside from minor ditchline infilling by organic material and brush on the outer edges of the road prism. The road is passable to pickup truck traffic. Surficial materials consist of moderately well drained sand and gravel fluvial deposits.		>2m	Mod. Well	**Very Low:** No landslide activity is possible. The road is situated on flat gradient terrain.	**N/A**	**N/A**	• Build up the road prism via import of granular material to tie into the elevation of Highway 37A. • Upgrade the existing road prism via minor ditch cleaning and brushing. Cut: 70% in moderately well drained fluvial deposits. Fill: 70% for fill of local material.	**N/A**	**N/A**
0+100 443873 6210705 **Sec. 1-B**	**1+140** 444022 6209692	0-40%	The alignment continues to track the existing road which traverses flat to moderate gradient planar to benched terrain. The existing road is in good condition aside from minor ditchline infilling by organic material and brush on the outer edges of the road prism. The road is passable to pickup truck traffic. Cross a small S6 stream at 1+075. The stream channel is approximately 1m wide by 0.1m deep and shows no signs of hydrogeomorphic activity. The stream passes through the road prism via a 600mm diameter culvert which is in good condition. Surficial materials consist of moderately well drained sand and gravel fluvial deposits.		>2m	Mod. Well	**Very Low:** No landslide activity is possible. The road is situated on flat gradient terrain.	**N/A**	**N/A**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Widen the alignment as needed by extending the road prism into cut. Cut: 70% in moderately well drained fluvial deposits. Fill: 70% for fill of local material.	**N/A**	**N/A**
1+140 444022 6209692 **Sec. 1-C**	**1+330** 444105 6209527	30-40% Below the alignment 40-55% Above the alignment	The alignment continues to track the existing alignment which swings around a broad, bedrock controlled ridge. Terrain is irregular and benched with moderate to moderately steep slope gradients. The existing road is in good condition aside from minor ditchline infilling by organic material and brush on the outer edges of the road prism. The road is passable to pickup truck traffic. By the end of the road section the alignment is immediately adjacent to Bitter Creek. Bedrock is extensive in the existing road cut and as a result the area is slated as a quarry for rock required further upchain on the alignment. The bedrock consists of massive, extremely strong granodiorite with widely spaced vertical jointing. The quarry area extends for 100-140m upslope of the road alignment giving an estimated area of approximately 2.2ha. It is expected that the majority of the quarry area will be utilized due to the large volume of bedrock required farther up the alignment, particularly in the Lim Creek area. Surficial materials consist of moderately well drained		0.5m	Mod. Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on moderate gradient terrain immediately downslope of the proposed alignment.	**N/A**	**N/A**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Widen the alignment as needed by extending the road prism into cut. Cut: 100% in moderately well drained colluvium deposits. 400% in granodiorite bedrock. Fill: 70% for fill of local material.	**N/A**	**N/A**

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Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
			rubble colluvium overlying granodiorite bedrock.									
1+330 444105 6209527 **Sec. 1-D**	**1+455** 444153 6209420	50-70% upslope of the alignment >100% downslope of the alignment into Bitter Creek.	A portion of the existing road prism has been washed out by a high flow event on Bitter Creek. Approximately 3-4m of the running surface of the road remains and a vertical eroded slope extends down to the floodplain of Bitter Creek. Vehicle access is not possible beyond this point. The washout is centered on a small stream draw and a damaged 600mm diameter culvert remains at the site. The culvert is located at 1+390. Flow was present on the stream at the time of fieldwork and the channel is <1m wide. The town side of the crossing over the stream draw is bedrock controlled and granodiorite bedrock is visible in the eroded road prism. The woods side of the crossing features deeper colluvium deposits and no bedrock is visible. Surficial materials consist of variable depth, moderately well drained rubble colluvium in a silty sand matrix.		0.5-2m	Mod. Well	**High:** Mid-sized (<1000m^3) fill slope failure due to fill slope erosion during high flows on Bitter Creek. The slide is expected to runout directly into Bitter Creek.	Sediment delivery to Bitter Creek. **High** Loss of access on the proposed road alignment. Reconstruction of the alignment could prove challenging. **High**	**V. High** **V. High**	• Reconstruct the road by shifting into cut 3-4m and placing a keyed in rock fill extending down to the flood plain of Bitter Creek. • Fill placement into the floodplain of Bitter Creek must adhere to the OEL Bitter Creek rock fill placement typical cross section drawing. • Excess material generated during reconstruction must be endhauled to a suitable waste site. Suitable waste sites are present from 0+000 to 1+140. • In areas where a keyed in rock fill is not placed and the alignment is shifted entirely into cut the crest of the eroded slope must be pulled back to 70% and must be armoured with angular rock. • Remove the damaged 600mm diameter culvert at the stream crossing at 1+390 and install an 800mm diameter culvert. Cut: 100% in moderately well drained colluvium deposits. 400% in granodiorite bedrock. Fill: 85% for fill of keyed in angular rock	**Low**	**Mod.** **Mod.**
1+455 444153 6209420 **Sec. 1-E**	**2+045** 444598 6209079	0-20%	The proposed road tracks the existing alignment along a small fluvial terrace adjacent to Bitter Creek. Terrain is benched with flat to gentle slope gradients. The existing road prism is in good condition aside from aside from minor ditchline infilling by organic material and brush on the road prism. The fluvial terrace that the road is situated on is composed of relatively poorly consolidated fluvial deposits. This type of material is easily eroded and as a result it is possible that the terrace and the proposed road could be impacted by an extreme flow event on Bitter Creek. Cross a small stream at 1+990. The stream channel is approximately 1m wide and appears to carry gravel to cobble sized debris seasonally. The material appears to deposit on flat to gentle gradient terrain prior to the proposed alignment. Surficial materials consist of moderately well drained sand and gravel fluvial deposits.		>2m	Mod. Well	**Moderate:** High flow event on Bitter Creek leading to erosion of the terrace that the road is situated on. The eroded material is expected to be entrained in Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**High**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Widen the alignment as needed by extending the road prism into cut. • Install an 800mm diameter culvert at 1+990 to address stream flow and minor material movement. • If the potential for washout of the alignment during a high flow event on Bitter Creek is not tolerable, then the bank of Bitter Creek adjacent to the proposed alignment should be armoured with angular rock to prevent erosion. Cut: 70% in moderately well drained fluvial deposits. Fill: 70% for fill of local material.	**Low**	**Mod.**
2+045 444598 6209079 **Sec. 1-F**	**2+140** 444690 6209053	70-80% above the alignment >100% downslope of the	A portion of the existing road prism has been washed out by a high flow event on Bitter Creek. Approximately 3-4m of the running surface of the road remains and a vertical eroded slope extends down to the floodplain of Bitter Creek. Bedrock is visible in the eroded slope and further		1-2m	Mod. Well	**High:** Mid-sized (<1000m^3) fill slope failure due to fill slope erosion during high flows on Bitter Creek. The slide is expected to runout directly into Bitter Creek.	Sediment delivery to Bitter Creek. **High** Loss of access on the proposed road alignment.	**V. High** **V. High**	• Reconstruct the road by shifting into cut 1-2m and placing a keyed in rock fill extending down to the flood plain of Bitter Creek. • Fill placement into the floodplain of Bitter Creek must adhere to the OEL Bitter Creek rock fill	**Low**	**Mod.** **Mod.**

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Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
		alignment into Bitter Creek.	retrogression of the slope into the road prism is not expected. Terrain above the alignment is planar to somewhat irregular with steep slope gradients. A small shift into cut (1-2m) is considered feasible however, moving the entire road prism into cut could result in a very large cut with associated cutslope instability. Surficial materials consist of a thin blanket of moderately well drained rubble colluvium in a silty sand matrix.					Reconstruction of the alignment could prove challenging. **High**		placement typical cross section drawing. • Excess material generated during reconstruction must be endhauled to a suitable waste site. Suitable waste sites are present from 0+000 to 1+140. Cut: 100% in moderately well drained colluvium deposits. 400% in granodiorite bedrock. Fill: 85% for fill of keyed in angular rock		
							Moderate: Small (<500m^3) cutslope failure due to a large cut extending into steep gradient terrain above the alignment. Runout is expected to terminate directly into Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**High**		**Low**	**Mod.**
2+140 444690 6209053 **Sec. 1-G**	**2+260** 444795 6208997	Vertical at the road cut and then 70-80% above the cut. >100% downslope of the alignment into Bitter Creek.	The majority of the existing road prism has been washed out by a high flow event on Bitter Creek. The remainder of the road prism is in bedrock and the road cut is also in bedrock. The bedrock consists of very strong granodiorite with jointing dipping slightly off vertical into the slope. The jointing configuration could result in a slightly overhung face on tall cuts. It does not appear feasible to trail to the top of the existing road cut to blast down due to steep slope gradients above the cut. A water polished bedrock bench remains within high water mark of Bitter Creek paralleling the road alignment. It appears that the eroded portion of the original road prism was founded on this bench feature. The alignment crosses a steep bedrock controlled gully at 2+180. The stream at the base of the gully appears to carry significant flow during the spring freshet period and during extreme precipitation events. The bedrock cut fades out on the woods side of the crossing and steep colluvium slopes are present. Surficial materials consist of a thin veneer of rubble colluvium on the town side of the crossing transitioning into a blanket of rubble colluvium in a silty sand matrix on the woods side of the crossing.		0m on the town side 1-2m on the woods side	Mod. Well	**High:** Mid-sized (<1000m^3) fill slope failure due to fill slope erosion during high flows on Bitter Creek. The slide is expected to runout directly into Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**V. High**	• Reconstruct the road by shifting slightly into cut and retaining the road fill through construction of a cast in place concrete wall founded on the bedrock bench paralleling Bitter Creek. • Fill retained by the concrete wall must consist of free draining shot rock. • Adhere to the OEL detailed design for the road section. • Excess material generated during reconstruction must be endhauled to a suitable waste site. Suitable waste sites are present from 0+000 to 1+140. • Install a 1000mm diameter culvert at 2+180 to address stream flow. • Scale the rock cut along the road section during and following the completion of construction activities. Cut: 100% in moderately well drained colluvium deposits. 400% in granodiorite bedrock. Fill: 85% for fill of keyed in angular rock	**Low**	**Mod.**
								Loss of access on the proposed road alignment. Reconstruction of the alignment could prove challenging. **High**	**V. High**			**Mod.**
							Moderate: Small scale (<1m^3) rock detachment from the large bedrock cut along this road section. Runout is expected to terminate on the proposed road.	Hazard to road users or road construction workers. **Moderate**	**Moderate**		**Low**	**Low**
2+260 444795 6208997 **Sec. 1-H**	**2+380** 444902 6208945	50-70% upslope >100% downslope of the alignment into Bitter Creek.	Approximately half of the road prism has been washed out by Bitter Creek and the remainder appears to be founded on a bedrock bench. A vertical eroded slope extends down from the remaining road prism into the floodplain of Bitter Creek. Bedrock is visible in the eroded slope and further retrogression of the slope into the road prism is not expected. Cross a small stream originating from a broad draw upslope of the alignment at 2+280. Surficial materials consist of a blanket of moderately well		1-2m	Mod. Well	**High:** Mid-sized (<1000m^3) fill slope failure due to fill slope erosion during high flows on Bitter Creek. The slide is expected to runout directly into Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**V. High**	• Reconstruct the road by shifting into cut 1-2m and placing a keyed in rock fill extending down to the flood plain of Bitter Creek. • Fill placement into the floodplain of Bitter Creek must adhere to the OEL Bitter Creek rock fill placement typical cross section drawing. • Excess material generated during reconstruction must be endhauled to a suitable waste site. Suitable waste sites are present from 0+000 to 1+140. Cut: 100% in moderately well drained colluvium deposits.	**Low**	**Mod.**
								Loss of access on the proposed road alignment. Reconstruction of the alignment could prove challenging. **High**	**V. High**			**Mod.**

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Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
			drained rubble colluvium in a silty sand matrix.							400% in granodiorite bedrock. Fill: 85% for fill of keyed in angular rock		
2+380 444902 6208945 **Sec. 1-I**	**2+615** 445124 6208862	60-70% upslope 0-10% below	The existing road has been completely washed out and the floodplain of Bitter Creek has expanded to the toe of the valley sidewall slope. A small cutslope failure is also present in what remains of the original road cutslope at 2+470. The failure is approximately 10m across by 25m long and reveals dense till deposits. Surficial materials consist of a blanket of moderately well drained dense silty sand with some gravel till deposits.		1-2m	Mod. Well	**High:** Mid-sized (<1000m^3) fill slope failure due to fill slope erosion during high flows on Bitter Creek. The slide is expected to runout directly into Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**V. High**	• Constructed the road via full fill methods in the floodplain of Bitter Creek. The road fill must be composed of keyed in rock. • Fill placement into the floodplain of Bitter Creek must adhere to the OEL Bitter Creek rock fill placement typical cross section drawing. Cut: N/A – Road is constructed via full fill method Fill: 85% for fill of keyed in angular rock	**Low**	**Mod.**
								Loss of access on the proposed road alignment. Reconstruction of the alignment could prove challenging. **High**	**V. High**			**Mod.**
							Moderate: Small (<500m^3) cutslope failure due to a large cut extending into moderate steep gradient terrain above the alignment. Runout is expected to terminate directly into Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**High**		**V. Low –** No cut into hillside with full fill	**Low**
2+615 445124 6208862 **Sec. 1-J**	**2+755** 445255 6208814	10-20% at the road location 60-70% upslope of the road	The alignment gains a section of intact road prism which is set approximately 10m back from the edge of the Bitter Creek floodplain. Seasonal high flows are not expected to cause the Bitter Creek floodplain to expend and impact the road alignment however, a larger high flow event or glacial outburst flood could cause further floodplain expansion. The existing road prism is in good condition aside from minor ditchline infilling by organic material and brush on the road prism. Cross a small stream at 2+735. The stream emerges from a small draw upslope of the road location. Surficial materials consist of well drained loose to compact sand and gravel fluvial deposits.		>2m	Well	**Moderate:** High flow event on Bitter Creek leading to floodplain expansion and erosion of the road prism. The road prism material is expected to become entrained in Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**High**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Widen the road as needed using conventional cut and fill methods. • Armour the bank of Bitter Creek with keyed in angular rock to prevent further erosion and floodplain expansion. • Install a 600mm diameter culvert at 2+735 to address stream flow. Cut: 70% in well drained fluvial deposits. Fill: 70% for fill of local material	**Low**	**Mod.**
								Loss of access on the proposed road alignment. Reconstruction of the alignment could prove challenging. **High**	**High**			**Mod.**
2+755 445255 6208814 **Sec. 1-K**	**2+930** 445423 6208776	50-70% upslope of the road 0-10% downslope of the road	The existing road has been completely washed out and the floodplain of Bitter Creek has expanded to the toe of the valley sidewall slope. A small surficial slide is present on the valley sidewall slope at 2+880. The slough is approximately 10m wide by 30m long and ranout into the floodplain of Bitter Creek. The slough is likely linked to toe of slope erosion associated with the expansion of the Bitter Creek floodplain. The road crosses a small section of imperfectly drained soils at 2+910. Minor seepage may be present in this		1-2m	Imperfect to Mod. Well	**High:** Mid-sized (<1000m^3) fill slope failure due to fill slope erosion during high flows on Bitter Creek. The slide is expected to runout directly into Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**V. High**	• Reconstruct the road by shifting into cut 1-2m and placing a keyed in rock fill extending down to the flood plain of Bitter Creek. • Fill placement into the floodplain of Bitter Creek must adhere to the OEL Bitter Creek rock fill placement typical cross section drawing. • Buttress the cutslope of the road where crossing the surficial slide (2+880) with keyed in angular rock. • Install a 600mm diameter culvert at 2+910 to address seepage flow.	**Low**	**Mod.**
								Loss of access on the proposed road alignment. Reconstruction of the alignment could prove challenging. **High**	**V. High**			**Mod.**

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Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
			location. Surficial materials consist of a blanket of imperfectly to moderately well drained rubble colluvium in a silty sand matrix.				**Moderate:** Small (<500m^3) cutslope failure due cutting into the valley sidewall slope where the previous surficial slide is located. Runout is expected to terminate directly into Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**High**	• Excess material generated during reconstruction must be endhauled to a suitable waste site. Suitable waste sites are present from 0+000 to 1+140. Cut: 100% in imperfectly to moderately well drained colluvium deposits. 400% in granodiorite bedrock. Fill: 85% for fill of keyed in angular rock	**Low**	**Mod.**
2+930 445423 6208776 **Sec. 1-L**	**3+115** 445580 6208680	0-20%	The alignment gains a section of intact road prism which is set approximately 20-30m back from the edge of the Bitter Creek floodplain. Seasonal high flows are not expected to cause the Bitter Creek floodplain to expend and impact the road alignment however, a larger high flow event or glacial outburst flood could cause further floodplain expansion. The existing road prism is in good condition aside from minor ditchline infilling by organic material and brush on the road prism. Cross a small stream at 2+970. The stream emerges from a small draw upslope of the road location. Surficial materials consist of moderately well drained loose to compact sand and gravel fluvial deposits.		>2m	Mod. Well	**Moderate:** High flow event on Bitter Creek leading to floodplain expansion and erosion of the road prism. The road prism material is expected to become entrained in Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**High**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Widen the road as needed using conventional cut and fill methods. • Armour the bank of Bitter Creek with keyed in angular rock to prevent further erosion and floodplain expansion. • Install a 600mm diameter culvert at 2+970 to address stream flow. Cut: 70% in well drained fluvial deposits. Fill: 70% for fill of local material	**Low**	**Mod.**
								Loss of access on the proposed road alignment. Reconstruction of the alignment could prove challenging. **High**	**High**			**Mod.**
3+115 445580 6208680 **Sec. 1-M**	**3+225** 445681 6208639	0-10%	The existing road has been completely washed out and the floodplain of Bitter Creek has expanded to the toe of the valley sidewall slope. Surficial materials consist of well drained loose to compact sand and gravel fluvial deposits.		>2m	Well	**High:** Mid-sized (<1000m^3) fill slope failure due to fill slope erosion during high flows on Bitter Creek. The slide is expected to runout directly into Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**V. High**	• Constructed the road via full fill methods in the floodplain of Bitter Creek. The road fill must be composed of keyed in rock. • Fill placement into the floodplain of Bitter Creek must adhere to the OEL Bitter Creek rock fill placement typical cross section drawing. Cut: N/A – Road is constructed via full fill method Fill: 85% for fill of keyed in angular rock	**Low**	**Mod.**
								Loss of access on the proposed road alignment. Reconstruction of the alignment could prove challenging. **High**	**V. High**			**Mod.**
3+225 445681 6208639 **Sec. 1-N**	**3+320** 445773 6208617	0-10%	The alignment gains a section of intact road prism which is set approximately 20-30m back from the edge of the Bitter Creek floodplain. Seasonal high flows are not expected to cause the Bitter Creek floodplain to expend and impact the road alignment however, a larger high flow event or glacial outburst flood could cause further floodplain expansion. The existing road prism is in good condition aside from minor ditchline infilling by organic material and brush on the road prism. A 1000mm diameter culvert is present at 3+280 on a small stream. The culvert is in good condition and is adequately sized to conduct peak flows on the stream.		>2m	Well	**Moderate:** High flow event on Bitter Creek leading to floodplain expansion and erosion of the road prism. The road prism material is expected to become entrained in Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**High**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Widen the road as needed using conventional cut and fill methods. • Armour the bank of Bitter Creek with keyed in angular rock to prevent further erosion and floodplain expansion. • Utilize the existing 1000mm diameter culvert at 3+280. Cut: 70% in well drained fluvial deposits. Fill: 70% for fill of local material	**Low**	**Mod.**
								Loss of access on the proposed road alignment. Reconstruction of the alignment could prove challenging. **High**	**High**			**Mod.**

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Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
			Surficial materials consist of well drained loose to compact sand and gravel fluvial deposits.									
3+320 445773 6208617 **Sec. 1-O**	**3+500** 445953 6208626	50-60% upslope of the road 0-10% downslope of the road	The existing road has been completely washed out and the floodplain of Bitter Creek has expanded to the toe of the valley sidewall slope. Surficial materials consist of a blanket of imperfectly to moderately well drained silty sand with some gravel till deposits.		1-2m	Imperfect to Mod. Well	**High:** Mid-sized (<1000m^3) fill slope failure due to fill slope erosion during high flows on Bitter Creek. The slide is expected to runout directly into Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**V. High**	• Reconstruct the road by shifting into cut 1-2m and placing a keyed in rock fill extending down to the flood plain of Bitter Creek. • Fill placement into the floodplain of Bitter Creek must adhere to the OEL Bitter Creek rock fill placement typical cross section drawing. Cut: 100% in imperfectly to moderately well drained colluvium deposits. 400% in granodiorite bedrock. Fill: 85% for fill of keyed in angular rock	**Low**	**Mod.**
								Loss of access on the proposed road alignment. Reconstruction of the alignment could prove challenging. **High**	**V. High**			**Mod.**
3+500 445953 6208626 **Sec. 1-P**	**3+940** 446388 6208589	0-10%	The alignment gains a section of intact road prism which is set approximately 10-20m back from the edge of the Bitter Creek floodplain. Seasonal high flows are not expected to cause the Bitter Creek floodplain to expend and impact the road alignment however, a larger high flow event or glacial outburst flood could cause further floodplain expansion. The existing road prism is in good condition aside from minor ditchline infilling by organic material and brush on the road prism. Cross a mid-sized stream with signs of debris flow activity at 3+545. The stream has constructed a small fan at the road location. The debris flow track is 4-6m wide and appears to transport cobble to small boulder sized sediments seasonally. The road was constructed out from the toe of the slope with a large ditchline in this location. The ditchline is mostly infilled with debris but material deposition on the running surface of the road has not yet occurred. Cross a second mid-sized stream with signs of debris flow activity at 3+690. The stream has constructed a small fan at the road location. The existing road was constructed with a large ditchline in this location and the fan deposit has not completely infilled the ditchline yet. The alignment crosses a smaller debris flow deposit at 3+790. The existing road was constructed with a large ditchline in this location and the debris flow deposit has not completely infilled the ditchline yet. Surficial materials consist of imperfectly drained loose to compact sand and gravel fluvial deposits.		>2m	Imperfect	**Moderate:** High flow event on Bitter Creek leading to floodplain expansion and erosion of the road prism. The road prism material is expected to become entrained in Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**High**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Widen the road as needed using conventional cut and fill methods. • Armour the bank of Bitter Creek with keyed in angular rock to prevent further erosion and floodplain expansion. • Install 1000mm dimeter culverts at 3+545 and 3+690 to address stream flow and to accommodate some sediment deposition at the site. • Install an 800mm diameter culvert at 3+790 to address stream flow and to accommodate some sediment deposition at the site. • Install a large (4m wide by 1m deep) ditchline to accommodate debris flow deposition adjacent to the road. • The ditchline will need to be cleaned seasonally due to what will likely be frequent debris flow events. Cut: 70% in imperfectly drained fluvial deposits. Fill: 70% for fill of local material	**Low**	**Mod.**
								Loss of access on the proposed road alignment. Reconstruction of the alignment could prove challenging. **High**	**High**			**Mod.**
							Moderate: Mid-sized (<1000m^3) debris flow event on the streams at 3+545, 3+690, and 3+790. Runout is expected to terminate on or adjacent to the proposed road alignment.	Chronic maintenance concern with frequent road blockage. **Moderate**	**Moderate**		**Low**	**Low**
3+940 446388 6208589	**4+010** 446463 6208599	70-80% upslope of the road	The alignment swings around a broad ridge feature on approach to a large landslide track. The existing road prism is intact in this location and		0-2m	Imperfect	**Moderate:** Small (<500m^3) cutslope failure due to further cutting at the slide site at 2+940. Runout is expected to	Sediment delivery to Bitter Creek. **Moderate**	**Moderate**	• Upgrade the existing road prism via widening by shifting the road into cut 4-5m. • Fill placement must occurring on the existing road	**Low**	**Low**

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Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
Sec. 1-Q		>100% downslope of the alignment into Bitter Creek.	appears to be constructed out of a bench blasted into local bedrock. The bedrock revealed in the road cut consists of very strong basalt and is standing up vertical. Construction through this area is expected to result in a large rock cut. A small cutslope failure has occurred at 3+940. The failure occurred in a small pocket of dense till material prior to the transition into shallow bedrock. The slump is <20m^3 in volume and deposited on the existing road alignment. Surficial materials consist of a veneer to thin blanket of silt and sand with some gravel till deposits.				terminate on the proposed road alignment with minor sediment delivery to Bitter Creek.			prism and must not extend over the edge of the existing road into the floodplain of Bitter Creek. • Fill must be constructed out of keyed in angular rock. • The road cutslope must be buttressed with keyed in angular rock at the cutslope failure site at 2+940. • Scale the rock cut along the road section during and following the completion of construction activities. Cut: 100% in imperfectly drained till deposits. 200% in basalt bedrock. Fill: 85% for fill of keyed in angular rock		
							Moderate: Small scale (<1m^3) rock detachment from the large bedrock cut along this road section. Runout is expected to terminate on the proposed road.	Hazard to road users or road construction workers. **Moderate**	**Moderate**		**Low**	**Low**
							High: Mid-sized (<1000m^3) fill slope failure due to fill placement extending over the edge of the existing road prism and into the floodplain of Bitter Creek with subsequent fill slope erosion by Bitter Creek. The slide is expected to runout directly into Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**V. High**		**Low**	**Mod.**
								Loss of access on the proposed road alignment. Reconstruction of the alignment could prove challenging. **High**	**V. High**			**Mod.**
4+010 446463 6208599 **Sec. 1-R**	**4+090** 446538 6208613	40-50% at the road location 70-80% upslope 100-120% into Bitter Creek	The alignment crosses a large landslide track. The existing road prism is completely destroyed. Terrain is irregular with moderately steep to steep slope gradients. A small moderate gradient bench remains where the proposed road alignment is located. The landslide track is approximately 40m wide and extends for 200m upslope. A small steam is flowing through the centre of the landslide track at 4+075. Aerial photography of the site indicates that the landslide predates road construction and may be associated with large snow avalanches which occur on the south side of the valley and may periodically dam Bitter Creek. The landslide may be the result of toe of slope erosion associated with the dammed Bitter Creek. Surficial materials consist of deep deposits of poorly to imperfectly drained silty sand with some gravel till. This material is dense and is standing near vertical in the sidewalls of the landslide track.		10-15m	Poor to Imperfect	**High:** Initiation of a large (>1000m^3) landslide in the existing landslide track due to loss of toe support on the slope during road construction. The slide is expected to runout directly into Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**V. High**	• Construct the road alignment through the landslide track by dropping the road grade, keying in large angular rock across the toe of the slope, and reconstructing the road fill out of keyed in angular rock or GRS. • Blanket the cutslope of the road with keyed in angular rock to the height of the maximum reach of an excavator. • Install a 600mm diameter culvert at 4+075 to address stream flow. • Install no stopping signage through the landslide track. • Expect an increased level of maintenance along this section of the alignment due to ongoing ravelling and sloughing in the landslide track. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: 100-120% in local till deposits supported with angular rock. Fill: 85% for fill of keyed in angular rock. 400% for fill constructed out of GRS.	**Mod.** – Small scale sloughing in the landslide track.	**Mod.**
								Loss of access on the proposed road alignment. Reconstruction of the alignment could prove challenging. **High**	**V. High**			**Mod.**
								Hazard to road users or road construction workers. **Moderate**	**High**			**Low**
							High: Mid-sized (<1000m^3) fill slope failure due to fill placement on steep to very steep gradient terrain leading into Bitter Creek and/or fill slope erosion due to Bitter Creek. The slide is expected to runout directly into Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**V. High**		**Low**	**Mod.**
								Loss of access on the proposed road alignment. Reconstruction of the alignment could prove	**V. High**			**Mod.**

Table 6.1: Red Mountain Gold Mine Access Route Section 1 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
								challenging. **High**				
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**		**Low**	**Low**
4+090 446538 6208613 **Sec. 1-S**	**4+230** 446671 6208585	80-200% upslope of the road 40-50% at the road location 60-80% into Bitter Creek	The alignment traverses the toe of a series of bedrock bluffs. The existing road prism has been mostly washed out and 2-3m of the road prism remains. A steep gradient scarp below the alignment leads directly down into Bitter Creek. The scarp appears to have eroded down to bedrock and as a result further major retrogression is not expected except under exceptional flow conditions on Bitter Creek (i.e. a glacial outburst flood). The bedrock bluffs upslope of the road location are composed of very weak black shale rock. Sheared areas of breccia or conglomerate were also noted in the rock mass as well as extensive calcite mineralization. The variable and sheared nature of the rock mass makes 1-2m^3 detachments common. Larger detachments are also possible if road construction undercuts the bedrock bluffs. Note that excavation and blasting of this lithology is expected to generate mainly cobble sized clasts which will be unsuitable for construction of keyed in rock fills. The south sidewall of the valley is still occupied by a large snow avalanche path. It is possible that the road alignment could be impacted by snow avalanche activity during the winter months. Surficial materials consist of a veneer of gravel to boulder sized rubble along the toe of the bedrock bluffs. This material is unconsolidated and loose. While the estimated depth to bedrock has been set to <0.5m, there may be localized lobes of deeper deposits along the toe of the bedrock bluffs.		<0.5m	Mod. Well	**High:** Frequent rockfall events from the bluffs overlying the road. The majority of detachments are expected to be on the order of 1-2m^3 although infrequent larger detachments may occur. Runout is expected to terminate on the proposed road. Even if runout extends to Bitter Creek, significant sediment delivery to the creek is not expected to occur as the rockfall will mainly be coarse angular rock rather than finer sediment.	Sediment delivery to Bitter Creek. **Low**	**Moderate**	• **Full Bench Cut construction.** Endhaul all excess material to a suitable waste site. Suitable waste sites are present from 0+000 to 1+050. • Place sliver fills of native material or keyed in angular rock on the existing road prism if required. • Scale the bedrock bluffs upslope of the road prior to and during road construction to ensure all loose or unstable blocks are removed. • Install rockfall hazard signage and continue the no stopping signage. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: 200% in black shale bedrock Fill: 70% for fill of local material 85% for fill of keyed in angular rock	**Mod.** – Small scale rock fall events	**Low**
								Hazard to road users or road construction workers. **Moderate**	**High**			**Low**
							High: Mid-sized (<1000m^3) fill slope failure due to fill placement on moderately steep to steep gradient terrain leading into Bitter Creek and/or fill slope erosion due to Bitter Creek. The slide is expected to runout directly into Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**V. High**		**Low**	**Mod.**
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**		**Low**	**Low**
4+230 446671 6208585 **Sec. 1-T**	**4+300** 446735 6208607	80-100% upslope of the road 120-150% into Bitter Creek.	The alignment crosses over a 6m deep, incised gully while dropping down to the Bitter Creek floodplain. The existing road prism has been mostly washed out and 2-3m of the road prism remains. The eroded scarp below the existing road reveals heavily fractured black shale bedrock. The base of the gully is located at 4+245. The gully appears to have eroded into an isolated plug of glaciolacustrine and till materials infilling an irregularity in the underlying bedrock surface. The glaciolacustrine		4m at the gully 1m outside of the gully	Imperfect to Mod. Well	**High:** Mid-sized (<1000m^3) cutslope failure at the gully location where glaciolacustrine deposits are present. Runout is expected to terminate in Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**V. High**	• Construct the road via cutting down through the gully and placing a large keyed in rock fill extending down to the Bitter Creek floodplain. • Significant rock volumes must be sourced from the proposed quarry at 1+140 to 1+330. • Fill placement into the floodplain of Bitter Creek must adhere to the OEL Bitter Creek rock fill placement typical cross section drawing. • Buttress the town side cut on the gully crossing	**Low**	**Mod.**
							Moderate: Debris flow event in the gully leading to blockage of the culvert and failure of the road prism.	Sediment delivery to Bitter Creek. **High**	**V. High**		**Low**	**Mod.**

Table 6.1: Red Mountain Gold Mine Access Route Section 1 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
			deposits appear to be mainly localized to the town side of the gully. The gully has failed at the existing road location in the glaciolacustrine deposits. The stream at the base of the gully is seasonal but appears to move significant sediment volumes and may host infrequent debris flow events. The geometry of the road alignment will require a large fill extending into the floodplain of Bitter Creek. The main channel of the creek is separated from the toe of the slope by 10-15m and would only be expected to be inundated under extreme flow conditions. The south sidewall of the valley is still occupied by a large snow avalanche path. It is possible that the road alignment could be impacted by snow avalanche activity during the winter months. Surficial materials consist of a veneer of rubble colluvium overlying black shale bedrock aside from a plug of layered fine sand and silt/clay glaciolacustrine deposits at the gully location.				Runout is expected to terminate in Bitter Creek.			where glaciolacustrine deposits are located with keyed in angular rock. The approximate dimensions of the buttress are 20m across by 4m tall. • Install a 1000mm diameter culvert at 4+245 in the base of the gully. The large size of the culvert is intended to allow for limited debris movement. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: 100% in glaciolacustrine materials buttressed with angular rock 100% in rubble colluvium deposits 200% in black shale bedrock Fill: 85% for fill of keyed in angular rock		
							High: Mid-sized (<1000m^3) fill slope failure due to fill placement on moderately steep to steep gradient terrain leading into Bitter Creek and/or fill slope erosion due to Bitter Creek. The slide is expected to runout directly into Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**V. High**		**Low**	**Mod.**
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**		**Low**	**Low**
4+300 446735 6208607 **Sec. 1-U**	**4+455** 446883 6208652	0-10% at the road location 70-90% above the road	The alignment traverses flat gradient terrain at the toe of the valley sidewall slope in the floodplain of Bitter Creek. The existing road prism is situated 20-30m up the slope from the proposed road. The prism has been completely buried by extensive cutslope instability as well as a large open slope failure extending from 4+360 to 4+400. Due to conditions along the existing road alignment coupled with very challenging conditions in the upcoming road section, the decision was made to locate the proposed alignment in the floodplain of Bitter Creek. By being situated in the floodplain of Bitter Creek the proposed road avoids the challenging conditions in the upslope area. Lim Creek is crossed at 4+445. The flow has mostly infiltrated at the road location in the floodplain of Bitter Creek. Upslope of the road location the creek is situated in a steep bedrock controlled gully and the channel is choked with gravel to boulder sized clasts from frequent rockfall events impinging on the channel. A portion of this material has been transported to the floodplain of Bitter Creek where a small truncated fan is present. The south sidewall of the valley is still occupied by a large snow avalanche path. In addition, the Lim Creek draw appears to host seasonal snow avalanche activity. It is possible that the road alignment could be impacted by snow avalanche activity during the winter months. Surficial materials consist of deep deposits of silty sand with some gravel till.		5m	Mod. Well	**High:** Erosion of the road prism during a high flow event on Bitter Creek. Entrainment of the road material in Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**V. High**	• **Full Fill construction.** Construct the road fill out of keyed in angular rock. • Fill placement into the floodplain of Bitter Creek must adhere to the OEL Bitter Creek rock fill placement typical cross section drawing. • Construct a rock ford over the Lim Creek crossing at 4+445. Install a 600mm diameter steel pipe to address stream flow. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: N/A – Full fill construction Fill: 85% for fill of keyed in angular rock.	**Low**	**Low**
								Loss of access on the proposed road alignment. Reconstruction of the alignment could prove challenging. **High**	**V. High**			**Low**
							Moderate: Further large scale landslide activity on the valley sidewall slope upslope of the proposed road location. Runout is expected to terminate adjacent to the proposed road location. No impact to the road is expected and the proposed construction is not expected to further increase the likelihood of a landslide on the slope.	Natural sediment delivery to Bitter Creek. **High**	**High**		**Mod** – Natural slide activity on the sidewall slope	**Mod –** Natural sediment delivery to Bitter Creek
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**		**Low**	**Low**

Table 6.1: Red Mountain Gold Mine Access Route Section 1 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
4+455 446883 6208652 **Sec. 1-V**	**4+610** 447032 6208627	0-10% at the road location 70-200% above the road	The alignment swings around a broad, bedrock controlled ridge of the woods side of Lim Creek. The proposed road is still situated in the floodplain of Bitter Creek. The existing road prism is situated approximately 25m upslope along the base of a series of large bedrock bluffs. The existing road prism has been completely buried by numerous rockfall events ranging in size up to 100-200m^3. The majority of these rockfall events terminate at the toe of the slope and are not expected to impact the proposed road alignment. The black shale bedrock described in the proceeding sections of the road table is cross cut by a series of andesitic dykes. The andesitic lithology is very strong and as a result breaks out of the surrounding black shale in much larger clasts ranging from 0.3-1.0m in size. The south sidewall of the valley is still occupied by a large snow avalanche path. It is possible that the road alignment could be impacted by snow avalanche activity during the winter months. Surficial materials consist of a blanket of angular, blocky andesitic colluvium.		2m	Well	**High:** Further natural rockfall events (up to 100-200m^3) occurring on the bluffs upslope of the proposed alignment. The events are expected to terminate prior or adjacent to the proposed road.	Sediment delivery to Bitter Creek. **Low**	**Moderate**	• **Full Fill construction.** Construct the road fill out of keyed in angular rock. • Fill placement into the floodplain of Bitter Creek must adhere to the OEL Bitter Creek rock fill placement typical cross section drawing. • Start no stopping and rockfall hazard signage. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: N/A – Full fill construction Fill: 85% for fill of keyed in angular rock.	**Mod** – Natural rockfall activity upslope of the road	**Low**
								Hazard to road users or road construction workers. **Low**	**Moderate**			**Low**
							High: Erosion of the road prism during a high flow event on Bitter Creek. Entrainment of the road material in Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**V. High**		**Low**	**Mod.**
								Loss of access on the proposed road alignment. Reconstruction of the alignment could prove challenging. **High**	**V. High**			**Mod.**
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**		**Low**	**Low**
4+610 447032 6208627 **Sec. 1-W**	**4+745** 447106 6208731	0-10% at the road location 100-200% above the road	The alignment traverses the toe of an eroded, failing bedrock slope. The proposed road prism is situated entirely within the main channel of Bitter Creek. The existing road prism is completely gone. It appears that an extreme flow event or possible glacial outburst flood occurred on Bitter Creek which eroded both the existing road prism and a portion of the bedrock controlled sidewall slope. The exposed, failing bedrock slope is composed of very weak, heavily fractured black shale cross cut by a series of very strong andesitic dykes. The slope is vertical to overhung in places and rockfall events appear to be common. The andesitic dykes are much more competent then the surrounding black shale lithology so when the andesitic material does fail, it tends to detach in relatively large blocks. The majority of these detachments are on the order of 1-2m^3 but larger 5-10m^3 detachments are considered possible. The south sidewall of the valley is still occupied by a large snow avalanche path. It is possible that the road alignment could be impacted by snow avalanche activity during the winter months.		<0.5m	Well	**High:** Further rockfall events occurring on the bluffs upslope of the proposed alignment. The events are expected to terminate prior or adjacent to the proposed road.	Sediment delivery to Bitter Creek. **Low**	**Moderate**	• **Full Fill construction.** Construct the road fill out of keyed in angular rock. • **Relocate the Bitter Creek channel to the southeast side of the floodplain.** • Adhere to the OEL Arrangement Drawing from 4+650 on the Red Mountain Access Road. • Construct a ditch and berm rockfall catchment structure along the inner edge of the road prism to mitigate the rockfall hazard at the site. • Scale the bedrock bluffs prior to and during construction. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: N/A – Full fill construction Fill: 85% for fill of keyed in angular rock.	**Mod** – Rockfall activity upslope of the road	**V. Low**
								Hazard to road users or road construction workers. **High**	**V. High**			**Low**
							High: Erosion of the road prism during a high flow event on Bitter Creek. Entrainment of the road material in Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**V. High**		**Low**	**Mod.**
								Loss of access on the proposed road alignment. Reconstruction of the alignment could prove challenging. **High**	**V. High**			**Mod.**
							High: Snow avalanche event impacts the alignment during	Hazard to road users or road	**High**		**Low**	**Low**

Table 6.1: Red Mountain Gold Mine Access Route Section 1 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
			Surficial material consists of a thin wedge of rubble colluvium along the toe of the slope overlying bedrock.				the winter season.	construction workers. **Moderate**				
4+745 447106 6208731 **Sec. 1-X**	**4+835** 447189 6208756	60-80%	The bedrock bluffs above the alignment end and the road climbs up to gain the existing road prism by the end of the section. The geometry of the site will still require a large keyed in rock fill toeing out in the floodplain of Bitter Creek. The existing road prism has slumped down, likely due to undercutting from Bitter Creek. A large cutslope failure is also present at the site extending up to the crest of the slope approximately 50m upslope of the proposed road location. The south sidewall of the valley is still occupied by a large snow avalanche path. It is possible that the road alignment could be impacted by snow avalanche activity during the winter months. Surficial materials consist of deep deposits of silty sand with some gravel till.		5m	Imperfect	**High:** Mid-sized (<1000m^3) cutslope failure during road construction. Runout is expected to terminate in Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**V. High**	• **Full Fill construction.** Construct the road fill out of keyed in angular rock. • Adhere to the OEL Arrangement Drawing from 4+650 on the Red Mountain Access Road. • Buttress the toe of the cutslope failure above the proposed road location with keyed in angular rock. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: N/A – Full fill construction Fill: 85% for fill of keyed in angular rock.	**Low**	**Low**
							High: Erosion of the road prism during a high flow event on Bitter Creek. Entrainment of the road material in Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**V. High**		**Low**	**Mod.**
								Loss of access on the proposed road alignment. Reconstruction of the alignment could prove challenging. **High**	**V. High**			**Mod.**
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**		**Low**	**Low**
4+835 447189 6208756 **Sec. 1-Y**	**5+030** 447344 6208857	10-20% at the road location 30-40% above the road	The proposed road alignment climbs up onto and tracks the existing road prism. The existing road prism is intact and in good condition aside from brush and minor ditchline infilling. The snow avalanche paths on the south side of the valley fade out and the Bitter Creek channel broadens. It is unlikely that the road will be impacted by snow avalanche activity. Surficial materials consist of deep deposits of silty sand with some gravel till.		5m	Imperfect to Mod. Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on gentle gradient terrain immediately downslope of the proposed alignment.	**N/A**	**N/A**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Widen the alignment as needed by extending the road prism into cut. Cut: 100% in moderately well to well drained till deposits Fill: 70% for fill of local material.	**N/A**	**N/A**
5+030 447344 6208857 **Sec. 1-Z**	**5+180** 447452 6208963	60-70% at and upslope of the road 0-10% downslope of the road	The existing road prism is completely washed out and the proposed road drops down into the floodplain of Bitter Creek. A small landslide track is present from 5+070 to 5+100. The landslide appears to be associated with toe of slope undercutting from Bitter Creek. The landslide headscarp reveals a pocket of glaciolacustrine material and significant seepage emergence was noted at the landslide headscarp. Due to the presence of glaciolacustrine materials at the site, cutting into the slope at the landslide location is not		>3m	Poor to Imperfect	**High:** Erosion of the road prism during a high flow event on Bitter Creek. Entrainment of the road material in Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**V. High**	• **Full Fill construction.** Construct the road fill out of keyed in angular rock in the floodplain of Bitter Creek. • Fill placement into the floodplain of Bitter Creek must adhere to the OEL Bitter Creek rock fill placement typical cross section drawing. • Buttress the existing landslide track where crossed by the road from 5+070 to 5+100 with a blanket of keyed in angular rock. Cut: N/A – Full fill construction	**Low**	**Mod.**
								Loss of access on the proposed road alignment. Reconstruction of the alignment could prove challenging. **High**	**V. High**			**Mod.**

Table 6.1: Red Mountain Gold Mine Access Route Section 1 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
			considered feasible. The glaciolacustrine materials are expected to continually fail and retrogress if cut into. Surficial materials consist of poorly to imperfectly drained silt and clay glaciolacustrine deposits. The material is soft where affected by water but is likely stiff where dry and insitu.				**High:** Large (>1000m^3) retrogressing cutslope failure due to road cuts in glaciolacustrine deposits. Runout is expected to terminate on the floodplain of Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**V. High**	Fill: 85% for fill of keyed in angular rock.	**Low**	**Mod.**
								Loss of access on the proposed road alignment. Reconstruction of the alignment could prove challenging. **High**	**V. High**			**Mod.**
5+180 447452 6208963 **Sec. 1-AA**	**5+300** 447558 6209015	40-50% at the road location 60-70% downslope of the road location	The proposed road alignment climbs up onto and tracks the existing road prism. The existing road prism is intact and in good condition aside from brush and minor ditchline infilling. A moderately steep gradient escarpment is present immediately downslope of the road location leading down to Bitter Creek. Surficial materials consist of moderately well drained rubble colluvium in a silty sand matrix.		>2m	Mod. Well	**Moderate:** Small (<500m^3) fill slope failure due to fill placement on moderately steep gradient terrain downslope of the road location. Runout is expected to terminate on the floodplain of Bitter Creek.	Sediment delivery to Bitter Creek. **High**	**High**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Widen the alignment as needed by extending the road prism into cut. Cut: 100% in moderately well drained colluvium deposits Fill: 70% for fill of local material.	**Low**	**Mod.**
5+300 447558 6209015 **Sec. 1-BB**	**5+500** 447716 6209113	10-40%	The alignment continues to track the existing road prism. The existing road prism is intact and in good condition aside from brush and minor ditchline infilling. The moderately steep gradient escarpment downslope of the road alignment fades out. Surficial materials consist of moderately well drained rubble colluvium in a silty sand matrix.		>2m	Mod. Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on gentle gradient terrain immediately downslope of the proposed alignment.	**N/A**	**N/A**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Widen the alignment as needed via cut and fill methods. Cut: 100% in moderately well drained colluvium deposits Fill: 70% for fill of local material.	**N/A**	**N/A**
5+500 447716 6209113 **Sec. 1-CC**	**5+650** 447841 6209191	40-50% at the road location 70-80% downslope of the road location	The alignment continues to track the existing road prism. The existing road prism is mainly intact aside from minor slumping along the outer edge of the road. It appears that minor fill placement may have occurred on the steep gradient terrain downslope of the road. Surficial materials consist of moderately well drained rubble colluvium in a silty sand matrix.		>2m	Mod. Well	**Moderate:** Small (<500m^3) fill slope failure due to fill placement on moderately steep gradient terrain downslope of the road location. Runout is expected to terminate on gentle gradient terrain prior to Bitter Creek.	Sediment delivery to Bitter Creek. **Moderate**	**Moderate**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Widen the alignment as needed by extending the road prism into cut. • Ensure that fill placement onto the steep gradient terrain downslope of the road does not occur. This may entail partial endhaul of the excavated material. Cut: 100% in moderately well drained colluvium deposits Fill: 70% for fill of local material.	**Low**	**Low**
5+650 447841 6209191 **Sec. 1-DD**	**5+745** 447925 6209239	50-60% upslope of the road 60-70% downslope of the road	The existing road alignment exhibits heavy tension cracking along the outer half of the road prism. A fill slope failure is present at 5+695 which ranout to the base of the valley sidewall slope adjacent to Bitter Creek. The fill instability appears to be a product of fill placement on moderately steep gradient terrain and possible organic material incorporated in the road prism. Surficial materials consist of moderately well drained		>2m	Mod. Well	**High:** Mid-sized (<1000m^3) fill slope failure due to additional loading of the existing road prism with tension cracks during road construction. Runout is expected to terminate at the base of the valley sidewall slope adjacent to the floodplain of Bitter	Sediment delivery to Bitter Creek. **Moderate**	**High**	• Upgrade the existing road by shifting into cut and pulling back the portion of the existing road prism with tension cracks. • Excess material generated during upgrade works must be endhauled to a suitable waste site. Suitable waste sites are present from 5+300 to 5+500. Cut: 100% in moderately well drained colluvium deposits	**Low**	**Low**

Table 6.1: Red Mountain Gold Mine Access Route Section 1 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
			rubble colluvium in a silty sand matrix.				Creek.			Fill: 70% for fill of local material.		
5+745 447925 6209239 **Sec. 1-EE**	**5+800** 447975 6209248	55-65% upslope of the road 50-55% downslope of the road	The tension cracking present along the existing road alignment fades out the road prism is in good condition. Terrain outside of the existing road prism is planar with moderate to moderately steep slope gradients. Surficial materials consist of moderately well drained rubble colluvium in a silty sand matrix.		>2m	Mod. Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on gentle gradient terrain approximately 60m downslope of the road location.	**N/A**	**N/A**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Widen the alignment as needed via cut and fill methods as needed. Cut: 100% in moderately well drained colluvium deposits Fill: 70% for fill of local material.	**N/A**	**N/A**
5+800 447975 6209248 **Sec. 1-FF**	**5+845** 448022 6209245	60-70%	The existing road alignment exhibits heavy tension cracking along the outer half of the road prism. The fill instability appears to be a product of fill placement on moderately steep gradient terrain and possible organic material incorporated in the road prism. Surficial materials consist of moderately well drained rubble colluvium in a silty sand matrix.		>2m	Mod. Well	**High:** Mid-sized (<1000m^3) fill slope failure due to additional loading of the existing road prism with tension cracks during road construction. Runout is expected to terminate at the base of the valley sidewall slope adjacent to the floodplain of Bitter Creek.	Sediment delivery to Bitter Creek. **Moderate**	**High**	• Upgrade the existing road by shifting into cut and pulling back the portion of the existing road prism with tension cracks. • Excess material generated during upgrade works must be endhauled to a suitable waste site. Suitable waste sites are present from 5+300 to 5+500. Cut: 100% in moderately well drained colluvium deposits Fill: 70% for fill of local material.	**Low**	**Low**
5+845 448022 6209245 **Sec. 1-GG**	**5+970** 448100 6209319	70-80% at the road location 20-30% above and below the road	The alignment wraps around a prominent ridge and begins to descend into the Radio Creek draw. The existing road prism is mainly intact but has been partially covered by cutslope raveling from large cuts along this section of the road. The alignment traverses the centre of a 50-60m long escarpment with steep slope gradients. Gentle gradient slopes are present above and below the road. Surficial materials consist of deep deposits of moderately well to well drained rubble colluvium in a silty sand matrix.		>5m	Mod. Well to Well	**Moderate:** Small scale cutslope sloughing and raveling due to large cuts in deep colluvium deposits. Runout is expected to terminate on the proposed road alignment.	Sediment delivery to Bitter Creek. **Low** Chronic maintenance concern with frequent road blockage. **Moderate**	**Low** **Moderate**	• Upgrade the road by shifting into cut. Excess material will be generated but can be utilized in the upcoming Radio Creek crossing. • Supported the toe of the cutslope with a 2 high lock block wall or staked rock wall if cutslope ravelling is problematic. Cut: 100% in moderately well drained colluvium deposits Fill: 70% for fill of local material.	**Low**	**V. Low** **Low**
5+970 448100 6209319 **Sec. 1-HH**	**6+090** 448189 6209384	30-40%	The alignment crosses through the base of the Radio Creek draw and crosses the creek at 6+010. The existing crossing structure over Radio Creek appears to have been removed and a channel has been constructed through the existing road prism to accommodate flow. The draw is not timbered and is vegetated with a heavy blanket of slide alder. This coupled with a review of orthoimagery of the site indicates that snow avalanche events may impact the site. Radio Creek is approximately 4m wide and has a channel gradient of 35% at the crossing location. The stream channel does not show signs of recent hydrogeomorphic activity (debris flow or debris flood events). Surficial materials consist of deep deposits of imperfectly drained sand/gravel/cobble fluvial deposits.		>5m	Imperfect	**High:** Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**	• Construct the road via full fill methods through the Radio Creek draw. • Install an 1800mm diameter culvert at 6+010 to address Radio Creek flow. Adhere to the OEL design for the crossing structure. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: N/A – Full fill construction Fill: 70% for fill of imported granular material	**Low**	**Low**
6+090	**6+240**	20-40% at	The alignment gains an elevated terrace feature		>10m	Well	**Moderate:** The proposed road	Sediment delivery	**Low**	• Construct the proposed road via a large thru cut	**Low**	**V. Low**

Table 6.1: Red Mountain Gold Mine Access Route Section 1 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
448189 6209384 **Sec. 1-II**	448327 6209399	the road location 70-80% downslope of the road location	approximately 100m upslope of the Bitter Creek floodplain. The existing road prism is intact and in good condition aside from brush growth and minor ditchline infilling. The vertical grade of the existing alignment is too steep for industrial traffic and as a result will need to be cut down. A large landslide track is present on the escarpment feature leading from the terrace down to Bitter Creek. The headscarp of the landslide is situated 30m downslope of 6+200 on the proposed road. The headscarp of the landslide track is not expected to retrogress far enough to impact the proposed road. The landslide appears to have occurred due to toe of slope erosion on a truncated ridge feature by Bitter Creek. The headscarp of the landslide also reveals layered glaciolacustrine deposits at depths of at least 10m in the landslide headscarp. The glaciolacustrine deposits are relatively impermeable to water and have created a perched groundwater table. The road appears to be situated in the area affected by snow avalanche activity. Surficial materials consist of deep deposits of well drained rubble colluvium in a silty sand matrix.				cut encountered glaciolacustrine materials during construction works. Significant ground water flows may be encountered and cutslope sloughing may result.	to Bitter Creek. **Low**		tracking the existing alignment. Excess material will be generated but can be utilized in the upcoming Radio Creek crossing. • Monitor the road cut for glaciolacustrine deposits. If glaciolacustrine deposits are encountered then project engineer must be contacted and the road construction plan at the site may be reviewed. Cut: 100% in moderately well drained colluvium deposits Fill: N/A – The road is in a thru cut		
								Chronic maintenance concern with frequent road blockage. **Moderate**	**Moderate**			**Low**
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**		**Low**	**Low**
6+240 448327 6209399 **Sec. 1-JJ**	**6+450** 448531 6209439	10-30% upslope of the road 70-80% downslope of the road	The proposed road tracks the existing road prism. The existing road prism is in good condition aside from brush growth and minor ditchline infilling. Terrain downslope of the road breaks over into a steep gradient escarpment leading down to the floodplain of Bitter Creek. The road appears to be situated in the area affected by snow avalanche activity. Surficial materials consist of deep deposits of well drained rubble colluvium in a silty sand matrix.		>5m	Well	**Moderate:** Small (<500m^3) fill slope failure due to fill placement on moderately steep gradient terrain downslope of the road location. Runout is expected to terminate on gentle gradient terrain adjacent to Bitter Creek.	Sediment delivery to Bitter Creek. **Moderate**	**Moderate**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Widen the alignment as needed through conventional cut and fill methods. • Ensure that fill placement onto the steep gradient terrain downslope of the road does not occur. Cut: 100% in moderately well drained colluvium deposits Fill: 70% for fill of local material.	**Low**	**Low**
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**		**Low**	**Low**
6+450 448531 6209439 **Sec. 1-KK**	**6+575** 448657 6209450	60-70% above and below the alignment	The alignment passes through an area where the existing road alignment encountered glaciolacustrine deposits. It appears that the existing road was in the process of being cut down when the glaciolacustrine deposits were encountered. An elevated groundwater table also appears to have been encountered in association with the glaciolacustrine deposits. It appears that the fill slope of the existing road saturated leading to a subsequent fill slope failure which ranout on gentle gradient terrain		>5m	Poor	**High:** Mid-sized (<1000m^3) fill slope failure due to fill saturation from cutslope seepage or construction of the fill slope out of fine grained glaciolacustrine material. Runout is expected to terminate on gentle gradient terrain approximately 50m downslope. Direct impact to	Sediment delivery to Bitter Creek. **Moderate**	**High**	• Reconstruct the road by shifting into cut and placing a small fill constructed out of granular material or keyed in rock. • Buttress the cutslope of the road with a blanket of keyed in angular rock as high as the excavator at the site can reach. • Install an oversized (2m wide by 1m deep) ditchline to capture expected seepage emergence from the perched ground water table.	**Low**	**Low**

Table 6.1: Red Mountain Gold Mine Access Route Section 1 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
			approximately 50m downslope. The road appears to leave the area where snow avalanche activity impacts the road alignment. Surficial materials consist of deep deposits of poorly drained silt and clay glaciolacustrine deposits. Dense silt and sand with some gravel till deposits appear to underlay the glaciolacustrine material.				Bitter Creek is not expected but sediment delivery may occur.			• Install 600mm diameter cross drain culverts at all seepage emergence sites. Cut: 100% in poorly drained glaciolacustrine deposits buttressed with keyed in rock. Fill: 70% for fill of imported granular material 85% for fill of keyed in angular rock		
							High: Small (<500m^3) cutslope failure due to large cuts in poorly drained glaciolacustrine deposits. Runout is expected to terminate on the existing road prism. Minor sediment delivery to Bitter Creek may occur.	Sediment delivery to Bitter Creek. **Moderate**	**High**		**Low**	**Low**
6+575 448657 6209450 **Sec. 1-LL**	**6+640** 448718 6209443	20-40%	The proposed alignment drops down onto a gentle gradient terrace and exits the area with glaciolacustrine deposits. The existing road prism is intact in this area and in relatively good condition. The road crosses a small steam draw at 6+610. The existing road was constructed as a large embankment fill through the stream draw. No signs of instability associated with the embankment fill were noted. Surficial materials consist of imperfect to moderately well drained sandy silt fluvial deposits.		>3m	Imperfect to Mod. Well	**Low:** Small fill slope failure due to improper fill placement. Runout is expected to terminate on gentle gradient slopes immediately downslope of the road location.	Sediment delivery to Bitter Creek. **Low**	**V. Low**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Widen the alignment as needed through conventional cut and fill methods. • Install a 600mm diameter culvert at 6+610 to address stream flow. • Armour the culvert inlet and outlet with angular rock to prevent erosion. Cut: 70% in imperfectly to moderately well drained fluvial deposits Fill: 70% for fill of local material.	**Low**	**V. Low**
6+640 448718 6209443 **Sec. 1-MM**	**7+130** 449194 6209449	0-20%	The proposed road tracks the existing road prism. The existing road prism is in good condition aside from brush growth and minor ditchline infilling. Cross a mid-sized stream flowing over the existing road prism at 6+745. The stream channel is 1-2m wide and has deposited a small lobe of sand to gravel sized sediments at the road location. Cross a mid-sized stream backing up in the ditchline of the existing road at 6+860. The stream channel is 1.0-1.5m wide. Surficial materials consist of imperfectly to moderately well drained silty sand with some gravel colluvium deposits.		>3m	Imperfect to Mod. Well	**Very Low:** The road is situated on flat gradient terrain and landslide activity is not expected.	**N/A**	**N/A**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Widen the alignment as needed through conventional cut and fill methods. • Install a 1000mm diameter culvert at 6+745 to address stream flow. The road surface will need to be lifted up in this location to provide cover for the culvert. • Install an 800mm diameter culvert at 6+860 to address stream flow. The road surface will need to be lifted up in this location to provide cover for the culvert. • Armour the inlet and outlet of both culverts to prevent erosion of the road prism. Cut: 100% in imperfectly to moderately well drained colluvium deposits Fill: 70% for fill of local material	**V. Low**	**N/A**
7+130 449194 6209449 **Sec. 1-NN**	**7+300** 449370 6209458	10-25%	The proposed alignment leaves the existing road and begins to approach the Roosevelt Creek crossing. The road traverses a gentle gradient terrain feature 10-15m out from the toe of a steeper escarpment. The escarpment is relatively wet with signs of substantial seepage emergence and may contain glaciolacustrine		>3m	Imperfect	**Moderate:** Small (<500m^3) surficial landslide if the proposed road disturbs the escarpment slope. Runout is expected to terminate on gentle gradient terrain	Sediment delivery to Bitter Creek. **Low**	**Low**	• Construct the road using conventional cut and fill methods. • Do not disturb the escarpment slope upslope of the road location. • Install an 800mm diameter culvert at 7+275 to	**Low**	**V. Low**

Table 6.1: Red Mountain Gold Mine Access Route Section 1 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
			deposits. The current road location avoids the escarpment feature. Cross a small stream at 7+275. The stream channel is <1m wide and has a gravel to cobble substrate. No signs of elevated flows or hydrogeomorphic activity were noted. Surficial materials consist of imperfectly drained gravelly sand fluvial deposits.				immediately downslope of the escarpment slope.			address stream flow. Cut: 70% in imperfectly drained fluvial deposits. Fill: 70% for fill of local material		
7+300 449370 6209458 **Sec. 1-OO**	**7+415** 449432 6209405	0-20%	The proposed alignment crosses over Roosevelt Creek. Terrain is somewhat irregular with gentle slope gradients. Cambria Creek is crossed 7+360. The channel is 10-20m wide with a boulder substrate. The stream channel is relatively low gradient and appears to host flood events. The stream is confined in a large draw upslope of the road location but loses confinement and fans out downslope of the road location. The Roosevelt Creek draw appears to host snow avalanche activity during the winter season. The road appears to be located in the distal portion of the snow avalanche path; however, impact to the alignment is considered possible by a high magnitude snow avalanche event. Surficial materials consist of imperfectly drained sand/gravel/cobble fluvial deposits.		>3m	Imperfect	**High:** Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**	• Cut and fill construction. • Install a XXXXXXXXXX as per OEL design. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: 70% in imperfectly drained fluvial deposits. Fill: 70% for fill of local material.	**Low**	**Low**
7+415 449432 6209405 **Sec. 1-PP**	**7+600** 449526 6209291	10-60%	The alignment crosses through the front nose of an elevated glaciofluvial terrace on the exit from the Roosevelt Creek draw. Terrain is stepped with gentle to moderately steep slope gradients. The moderately steep gradient pitches are relatively short (20m long) and bounded by gentle gradient terraces. Surficial materials consist of deep deposits of moderately well drained gravelly sand with trace to some silt glaciofluvial deposits.		>5m	Mod. Well	**Moderate**: Small scale cutslope raveling and retrogression due to expected large cut size. Runout is expected to terminate on the proposed road alignment.	Sediment delivery to Bitter Creek. **Low** Sediment delivery to Roosevelt Creek. **Low**	**Low** **Low**	• Cut and fill construction shifting into a large thru cut through the glaciofluvial terrain. • Clean and maintain ditchlines seasonally due to expected cutslope ravelling and sloughing. Cut: 70-100% in moderately well drained glaciofluvial deposits. Fill: 70% for fill of local material.	**Mod.** – Small scale cutslope sloughing	**Low** **Low**
7+600 449526 6209291 **Sec. 1-QQ**	**8+520** 450409 6209042	10-20%	The proposed alignment tracks an existing road situated on a gentle gradient glaciofluvial terrace. A 70-85% escarpment is situated 40-80m upslope of the road location. The existing road prism is intact and in good condition aside from heavy brush on the running surface and minor organic material infilling of the ditchline. Existing 600mm diameter culverts were noted at seepage sites at the following locations: • 7+530 • 7+720		>5m	Mod. Well	**Very Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on gentle gradient terrain immediately downslope of the proposed road location. No impact to elements at risk is expected.	**N/A**	**N/A**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Widen the alignment as needed by extending the road prism into cut or importing material to extend the road fill. Cut: 70% in moderately well drained glaciofluvial deposits. Fill: 70% for fill of local material.	**V. Low**	**N/A**

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Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
			• 8+145 Surficial materials consist of deep deposits of moderately well drained gravelly sand with trace to some silt glaciofluvial deposits.									
8+520 450409 6209042 **Sec. 1-RR**	**8+635** 450515 6209002	10-20%	The proposed alignment tracks an existing road situated on a gentle gradient glaciofluvial terrace. A meander in Bitter Creek which heads to the northeast reaches a minimum distance of 18m from the toe of the fill slope of the proposed road at 8+590. The meander cut is 10-12m tall and likely formed during a recent extreme flow event on Bitter Creek. The meander cut exposes deep deposits of gravelly sand with trace silt glaciofluvial material with is actively raveling. The meander appears to be the product of bedrock outcropping on the southern side of Bitter Creek which pushes the creek to the northeast. The natural morphology of Bitter Creek is not that of a low energy, widely meandering stream. It is considered unlikely that the meander cut would retrogress far enough to the northeast to impact the proposed alignment. The only conditions under which this could be considered possible is if an extreme flow event such as a glacial outburst flood occurred. Surficial materials consist of deep deposits of moderately well drained gravelly sand with trace to some silt glaciofluvial deposits.		>5m	Mod. Well	**Very Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on gentle gradient terrain immediately downslope of the proposed road location. No impact to elements at risk is expected.	**N/A**	**N/A**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Widen the alignment as needed by extending the road prism into cut or importing material to extend the road fill. Cut: 70% in moderately well drained glaciofluvial deposits. Fill: 70% for fill of local material.	**V. Low**	**N/A**
							Low: Continued retrogression of the meander cut leading to eventual erosion of the road fillslope and prism.	**N/A**	**N/A**		**Low**	**N/A**
8+635 450515 6209002 **Sec. 1-SS**	**8+995** 450753 6208895	10-20%	The proposed alignment tracks an existing road situated on a gentle gradient glaciofluvial terrace. The existing road prism is intact and in good condition aside from heavy brush on the running surface and minor organic material infilling of the ditchline. Surficial materials consist of deep deposits of moderately well drained gravelly sand with trace to some silt glaciofluvial deposits.		>5m	Mod. Well	**Very Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on gentle gradient terrain immediately downslope of the proposed road location. No impact to elements at risk is expected.	**N/A**	**N/A**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Widen the alignment as needed by extending the road prism into cut or importing material to extend the road fill. Cut: 70% in moderately well drained glaciofluvial deposits. Fill: 70% for fill of local material.	**V. Low**	**N/A**
8+995 450753 6208895 **Sec. 1-TT**	**9+280** 451116 6208788	10-30%	The proposed alignment tracks an existing road situated on a gentle gradient glaciofluvial terrace. A 70-85% escarpment is situated 30-60m upslope of the road location. The escarpment upslope of the road location is the site of a number of open slope failures. The landslides appear to be natural events associated with relatively young unconsolidated sediments deposited at a relatively steep slope angle. The landslides have all deposited on gentle gradient terrain upslope of the road location. No signs of runout to the proposed road location were noted. The existing road prism is intact and in good condition		>5m	Mod. Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on gentle gradient terrain immediately downslope of the proposed road location. No impact to elements at risk is expected.	**N/A**	**N/A**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Widen the alignment as needed by extending the road prism into cut or importing material to extend the road fill. Cut: 70% in moderately well drained glaciofluvial deposits. Fill: 70% for fill of local material.	**Low**	**N/A**
							High: Further natural landslide activity on the escarpment upslope of the road location.	Sediment delivery to Bitter Creek. **Low**	**Moderate**		**High** – Further natural	**Mod.**

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Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
			aside from heavy brush on the running surface and minor organic material infilling of the ditchline. Surficial materials consist of deep deposits of moderately well drained gravelly sand with trace to some silt glaciofluvial deposits.				Runout is expected to terminate at the toe of the slope prior to the proposed road location.				landslide activity on the escarpment upslope of the road location	
9+280 451116 6208788 **Sec. 1-UU**	**9+500** 451265 6208640	10-35% at the road location Short pitch of 80% below the road location 70-80% Upslope of the road location	The proposed alignment continues to track a small gentle gradient terrace feature. A short (<20m long) escarpment is present immediately downslope of the road location followed by gentle gradient terrain. Steep gradient terrain is present 30-50m upslope of the road location. The existing road prism is intact and in good condition aside from heavy brush on the running surface and minor organic material infilling of the ditchline. Surficial materials consist of deep deposits of moderately well drained gravelly sand with trace to some silt glaciofluvial deposits.		>5m	Mod. Well	**Moderate:** Small (<500m^3) fill slope failure due to fill placement extending onto the steep gradient escarpment immediately downslope of the road location. Runout is expected to terminate on gentle gradient terrain approximately 20m downslope.	Sediment delivery to Bitter Creek. **Low**	**Low**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Widen the alignment as needed by extending the road prism into cut. • Ensure that fill material is not placed over the crest of the escarpment slope during road upgrade works. Cut: 70% in moderately well drained glaciofluvial deposits. Fill: 70% for fill of local material.	**Low**	**V. Low**
9+500 451265 6208640 **Sec. 1-VV**	**9+555** 451262 6208586	20-40%	The proposed alignment crosses over Cambria Creek. Terrain is somewhat irregular with moderate slope gradients. Cambria Creek is crossed at 9+535. The channel is 8-10m wide with a boulder substrate. The stream appears to regularly conduct debris flow and debris flood events. The stream is confined in a large draw upslope of the road location but loses confinement and fans out downslope of the road location. Numerous abandoned channels and debris lobes are present in the downslope area. The crossing structure at the site must account for the potential for debris flow or debris flood activity on the stream. The Cambria Creek draw appears to host snow avalanche activity during the winter season. The road appears to be located in the distal portion of the snow avalanche path; however, impact to the alignment is considered possible by a high magnitude snow avalanche event. Surficial materials consist of deep deposits of imperfectly to moderately well drained gravelly sand with trace to some silt glaciofluvial deposits.		>5m	Imperfect to Mod. Well	**High:** Large (>1000m^3) debris flow or debris flood event on Cambria Creek. Impact to the road prism and crossing structure.	Sediment delivery to Bitter Creek. **Moderate**	**High**	• Cut and fill construction. • Install a XXXXXXXXXX as per OEL design. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: 70-100% in imperfectly to moderately well drained glaciofluvial deposits. Fill: 70% for fill of local material.	**Low**	**Low**
								Damage to the crossing structure over Cambria Creek. **Moderate**	**High**			**Low**
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**		**Low**	**Low**
9+555 451262 6208586 **Sec. 1-WW**	**9+835** 451389 6208362	60-70% Breaks to 10-20% approximately 20m downslope	Terrain is planar to somewhat irregular with moderately steep slope gradients. The proposed alignment continues to track the existing alignment. The existing road prism is intact and in good condition aside from heavy brush on the running surface and minor infilling of the ditchline.		>5m	Mod. Well to Well	**Moderate:** Small (<500m^3) fill slope failure due to fill placement on moderately steep gradient terrain immediately downslope of the road location. Runout is expected to terminate on	Sediment delivery to Bitter Creek. **Low**	**Low**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Widen the alignment as needed by extending the road prism into cut. • Ensure that the fill slope of the road is not enlarged substantially. This may entail end hauling a portion	**Low**	**V. Low**

Table 6.1: Red Mountain Gold Mine Access Route Section 1 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
			The existing road appears to have been constructed with ½ to ¾ bench cut with a sidecast fill of native material. The fill slope is oversteepened to approximately 80% but shows no signs of instability such as tension cracking or road prism displacement. Surficial materials consist of deep deposits of moderately well to well drained gravelly sand with trace to some silt glaciofluvial deposits.				gentle gradient terrain 20-30m downslope of the proposed road location.			of the generated material if the road prism is expanded into cut. • If end hauling is required then material may be spoiled on the gentle gradient slopes present downslope of the proposed road from 8+635 to 9+280. Cut: 100% in moderately well to well drained glaciofluvial deposits. Fill: 70% for fill of local material.		
9+835 451389 6208362 **Sec. 1-XX**	**10+660** 451839 6207733	5-30%	The existing road pulls away from the moderately steep gradient slope crossed in the preceding road section and traverses gentle to moderate gradient terrain. The proposed alignment tracks the existing alignment. The existing road prism is intact and in good condition aside from heavy brush on the running surface and minor organic material infilling of the ditchline. A small S6 stream enters the ditchline of the road at 10+260 and then flows upchain along the ditchline of the road to twin 1000mm diameter culverts. The stream channel is 1-2m wide by 0.1m deep and both the ditchline and the culverts appear to be adequately sized to conduct peak flows on the stream. A small stream is crossed at 10+545. The stream channel is <1m wide and flows through an existing 1600mm diameter culvert. No signs of elevated flows or hydrogeomorphic activity were noted on the stream. Another small stream is crossed at 10+590. The stream channel is <1m wide and flows through an existing 1600mm diameter culvert. No signs of elevated flows or hydrogeomorphic activity were noted on the stream. Surficial materials consist of deep deposits of imperfect to moderately well drained drained gravelly sand with trace to some silt glaciofluvial deposits.		>5m	Imperfect to Mod. Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on gentle gradient terrain immediately downslope of the proposed road location. No impact to elements at risk is expected.	**N/A**	**N/A**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Widen the alignment as needed by extending the road prism into cut or importing material to extend the road fill. Cut: 70-100% in imperfectly to moderately well drained glaciofluvial deposits. Fill: 70% for fill of local material.	**Low**	**N/A**
10+660 451839 6207733 **Sec. 1-YY**	**10+775** 451889 6207629	10-20% at and above the road location Short pitch of 70-80% extending down to gentle gradient terrain.	Terrain is benched and somewhat irregular with gentle slope gradients at the road location and a short pitch of steep gradient terrain below the road location. The proposed alignment continues to track the existing alignment. The existing road prism is intact and in good condition aside from heavy brush on the running surface and minor infilling of the ditchline. Surficial materials consist of deep deposits of moderately well drained gravelly sand with trace to some silt glaciofluvial deposits.		>5m	Mod. Well	**Moderate:** Small (<500m^3) fill slope failure due to fill placement on moderately steep gradient terrain immediately downslope of the road location. Runout is expected to terminate on gentle gradient terrain approximately 30m downslope of the proposed road location.	Sediment delivery to Bitter Creek. **Low**	**Low**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Widen the alignment as needed by extending the road prism into cut. • Ensure that the fill slope of the road is not enlarged substantially. This may entail end hauling a portion of the generated material if the road prism is expanded into cut. • If end hauling is required then material may be spoiled on the gentle gradient slopes present downslope of the proposed road from 8+635 to 9+280. Cut: 70-100% in moderately well to well drained	**Low**	**V. Low**

Table 6.1: Red Mountain Gold Mine Access Route Section 1 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
										glaciofluvial deposits. Fill: 70% for fill of local material.		
10+775 451889 6207629 **Sec. 1-ZZ**	**10+815** 451898 6207591	10-20% at and above the road location Short pitch of 70-80% extending down to gentle gradient terrain	Terrain is benched and somewhat irregular with gentle slope gradients at the road location and a short pitch of steep gradient terrain below the road location. The proposed alignment continues to track the existing alignment. A large tension crack was noted extending along the outer edge of the existing road alignment for approximately 40m. The tension crack has affected the outer 2-3m of the road prism and shows approximately 0.3m of displacement. It appears that a portion of the existing road fill extends onto the steep gradient terrain underlying the alignment and has begun to creep downslope. Surficial materials consist of deep deposits of moderately well drained gravelly sand with trace to some silt glaciofluvial deposits.		>5m	Mod. Well	**High:** Mid-sized (<1000m^3) fill slope failure due to continued movement in the existing road prism or additional fill placement on steep gradient terrain underlying the alignment. Runout is expected to terminate on gentle gradient terrain approximately 30-40m downslope.	Sediment delivery to Bitter Creek. **Low**	**Moderate**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Pullback the outer 2-3m of the road prism and the associated fill slope (Area delineated by the tension crack) and endhaul the generated material to a suitable waste site. A suitable waste site is located at the large landing at 10+735. • Shift the road into cut to achieve the desired road width. Cut: 70-100% in moderately well to well drained glaciofluvial deposits. Fill: 70% for fill of local material.	**Low**	**V. Low**
10+815 451898 6207591 **Sec. 1-AAA**	**10+895** 451887 6207519	40-50%	Terrain is benched and somewhat irregular with moderate slope gradients. The proposed alignment continues to track the existing alignment. The existing road prism is intact and in good condition aside from heavy brush on the running surface and minor infilling of the ditchline. A large (approximately 4m diameter) boulder is situated at the inner edge of the existing road alignment at 10+890. It appears that previous road works excavated around the boulder rather than the boulder being deposited from above. The boulder appears to impede sightlines along the road and may need to be removed during road upgrade works. Surficial materials consist of deep deposits of moderately well drained gravelly sand with trace to some silt glaciofluvial deposits.		>5m	Mod. Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on gentle gradient terrain approximately 60m downslope of the proposed road location.	**N/A**	**N/A**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Widen the alignment as needed by extending the road prism into cut or importing material to extend the road fill. • Remove the boulder at 10+890 during road upgrade works. This will likely require blasting. Cut: 70-100% in moderately well drained glaciofluvial deposits. Fill: 70% for fill of local material.	**Low**	**N/A**
10+895 451887 6207519 **Sec. 1-BBB**	**10+935** 451951 6207486	75-85% upslope of the road location 60-70% at the road location 20-30% slopes are present 20m downslope of	The proposed alignment continues to track the existing alignment. The existing road prism is intact and in good condition aside from heavy brush on the running surface and minor infilling of the ditchline. The alignment is now situated on moderately steep gradient terrain with a 40-50m long slope of 75-85% terrain above the alignment. Larger cuts into the slope above the road are expected to ravel and retrogress until the crest of the slope is reached 40-50m upslope. Surficial materials consist of deep deposits of moderately well drained gravelly sand with trace to some silt		>5m	Mod. Well	**High:** Mid-sized (<1000m^3) retrogressing cutslope failure due to cuts into steep gradient terrain above the alignment. Runout is expected to terminate on gentle gradient terrain 20-30m downslope of the road location.	Sediment delivery to Bitter Creek. **Low**	**Moderate**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Widen the alignment as needed by importing material to extend the road fill. • Avoid large cuts into the slope above the proposed alignment. If cuts are required into the overlying slope then support the cutslope with a keyed in rock buttress or 2 high line of lock blocks. • Ensure all organic material is stripped prior to fill placement and the fill is constructed out of free	**Low**	**V. Low**
								Chronic loss of access on the proposed road alignment. Frequent maintenance required. **Moderate**	**High**			**Low**

Table 6.1: Red Mountain Gold Mine Access Route Section 1 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
		the road location	glaciofluvial deposits.				**Moderate**: Mid-sized (<1000m^3) fill slope failure due to improper placement of a large amount of fill material. It is also possible that the placed fill material could fail if all of the organic material underlying the fill footprint is not fully stripped. Runout is expected to terminate on the 20-30% terrain approximately 20m downslope of the road location.	Sediment delivery to Bitter Creek. **Low**	**Low**	draining granular material placed in lifts and nominally compacted. • Alternatively construct the fill out of keyed in angular rock founded on a natural or excavated bench. Cut: 100% in moderately well drained glaciofluvial deposits. Fill: 70% for fill of local or imported granular material. 85% for fill of keyed in angular rock.	**Low**	**V. Low**
10+935 451951 6207486 **Sec. 1-CCC**	**11+115** 451968 6207327	75-85% upslope of the road location 60% for 15m downslope of the road 30% continuing downslope	The proposed alignment continues to track the existing road. The road prism is intact for the most part but small scale cutslope raveling and sloughing has deposited 30-40m^3 of material along the inner edge of the alignment. Further cuts into the slope above the alignment have the potential to exacerbate the sloughing. Below the proposed alignment a 60% slope extends for approximately 15m prior to 30% terrain continuing downslope. Surficial materials consist of deep deposits of moderately well drained gravelly sand with trace to some silt glaciofluvial deposits.		>5m	Mod. Well	**High:** Large (>1000m^3) retrogressing cutslope failure due to cuts into steep gradient terrain above the alignment. Runout is expected to terminate on gentle gradient terrain 15mm downslope of the road location.	Sediment delivery to Bitter Creek. **Low**	**Moderate**	• Upgrade the existing road prism by clearing off the material deposited from the cutslope sloughing. • Widen the alignment as needed by importing material to extend the road fill. • Ensure all organic material is stripped prior to fill placement and the fill is constructed out of free draining granular material placed in lifts and nominally compacted. • Do not expand the cutslope of the existing road. • Alternatively construct the fill out of keyed in angular rock founded on a natural or excavated bench. Cut: 100% in moderately well drained glaciofluvial deposits. Fill: 70% for fill of local or imported granular material. 85% for fill of keyed in angular rock.	**Mod.** – Small scale cutslope sloughing	**Low**
								Chronic loss of access on the proposed road alignment. Frequent maintenance required. **Moderate**	**High**			**Mod.**
							Moderate: Mid-sized (<1000m^3) fill slope failure due to improper placement of a large amount of fill material. It is also possible that the placed fill material could fail if all of the organic material underlying the fill footprint is not fully stripped. Runout is expected to terminate on the 20-30% terrain approximately 20m downslope of the road location.	Sediment delivery to Bitter Creek. **Low**	**Low**		**Low**	**V. Low**
11+115 451968 6207327 **Sec. 1-DDD**	**11+295** 451977 6207147	20-40%	The steep escarpment slope above the proposed alignment pulls away and the proposed alignment continues to track the existing road through gentle to moderate gradient benched terrain. Cross a small S6 stream at 11+140. The stream channel is <1m wide and shows no signs of elevated flows or recent hydrogeomorphic activity. The stream passes through the existing road prism via a 1000mm diameter culvert which is in good condition. Surficial materials consist of deep deposits of imperfect		>5m	Imperfect to Mod. Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on gentle gradient terrain approximately 60m downslope of the proposed road location.	**N/A**	**N/A**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Widen the alignment as needed by extending the road prism into cut or importing material to extend the road fill. • Utilize the existing 1000mm diameter culvert at 11+140 provided that it is of adequate length for the proposed road prism. Cut: 70-100% in imperfectly to moderately well drained glaciofluvial deposits.	**Low**	**N/A**

Table 6.1: Red Mountain Gold Mine Access Route Section 1 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
			to moderately well drained gravelly sand with trace to some silt glaciofluvial deposits.							Fill: 70% for fill of local material.		
11+295 451977 6207147 **Sec. 1-EEE**	**11+385** 451980 6207058		The proposed alignment crosses over the Hartley Gulch fan, continuing to track the existing road alignment. Terrain is planar to somewhat irregular with gentle to moderate slope gradients. Hartley Gulch Creek is crossed at 11+345. The channel is 10-12m wide with a boulder substrate. The stream appears to regularly conduct debris flow and debris flood events. The stream is confined in a large draw upslope of the road location but loses confinement and fans out downslope of the road location. Numerous abandoned channels and debris lobes are present in the downslope area. The crossing structure at the site must account for the potential for debris flow or debris flood activity on the stream. The Hartley Gulch Creek draw appears to host snow avalanche activity during the winter season. The road appears to be located in the distal portion of the snow avalanche path; however, impact to the alignment is considered possible by a high magnitude snow avalanche event. Surficial materials consist of deep deposits of imperfect to moderately well drained gravelly sand with trace to some silt glaciofluvial deposits.		>5m	Imperfect to Mod. Well	**High:** Large natural debris flow event on Hartley Gulch Creek. Channel avulsion and washout of the road prism. Possible impact to the crossing structure. A portion of the road prism material will be entrained and transported downstream to Bitter Creek.	Damage to the crossing structure over Hartley Gulch Creek. **High**	**V. High**	• Cut and fill construction. • Install a XXXXXXXXXX as per OEL design. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: 70-100% in imperfectly to moderately well drained glaciofluvial deposits. Fill: 70% for fill of local material. *The construction recommendations provided in this table will not affect the likelihood of a debris flow event on the stream but will reduce the impact to the elements at risk. i.e. the P(H) will remain the same but the P(S:H) will decline.	**High*** – Natural debris flow event on the stream	**Mod.**
								Sediment delivery to Bitter Creek. **High**	**V. High**			**Mod.**
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**		**Low**	**Low**
11+385 451980 6207058 **Sec. 1-FFF**	**11+870** 452077 6206580	30-50%	The proposed alignment continues to track the existing road. The existing road prism is in good condition aside from brush growth and minor ditchline infilling. Terrain surrounding the existing road is planar with moderate slope gradients. Surficial materials consist of deep deposits of well drained gravelly sand with trace to some silt glaciofluvial deposits.		>3m	Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on moderate gradient terrain immediately downslope of the proposed road.	Sediment delivery to Bitter Creek. **Low**	**V. Low**	• Upgrade the existing road prism via minor ditch cleaning and brushing. • Widen the alignment as needed by extending the road prism into cut. Cut: 100% in well drained glaciofluvial deposits. Fill: 70% for fill of local material.	**Low**	**N/A**
11+870 452077 6206580 **Sec. 1-GGG**	**12+130** 452112 6206323	30-45%	The proposed alignment continues to track the existing road. The existing road prism is in relatively poor condition as it has been impacted by a number of streams which have infilled the culverts on the road, eroded the road prism, and deposited material on the road surface. Cross a mid-sized stream at 11+920 which has washed out the road prism. The stream as multiple channels and appears to transport significant material volumes during the spring freshet.		>3m	Imperfect	**High:** Further debris transport on the streams leading to culvert blockage and road prism washout. Entrainment of the road prism material and transport of minor sediment volumes to Bitter Creek.	Sediment delivery to Bitter Creek. **Moderate**	**High**	• Upgrade the road by cleaning off the road prism and ditchlines. • Widen the alignment as needed using cut and fill methods. • Install a 1200mm diameter culvert at 11+920 to address stream flow and sediment transport down the stream. • Install 1000mm diameter culverts at 11+995 and 12+025 to address stream flow and sediment	**Low**	**Low**

Table 6.1: Red Mountain Gold Mine Access Route Section 1 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
			Cross a mid-sized stream at 11+995. The stream channel is 1-2m wide and appears to transport significant material volumes during the spring freshet. The stream has blocked the road alignment. Cross a mid-sized stream at 12+025. The stream channel is 1-2m wide and appears to transport significant material volumes during the spring freshet. The stream has blocked the road alignment. Cross a mid-sized stream at 12+075 which is situated in the centre of a landslide track. The landslide appears to be a natural event unrelated to the existing road alignment. The landslide debris has blocked the road alignment. Surficial materials consist of deep deposits of imperfectly drained silty sand with some gravel till deposits.							transport down the streams. • Install an 800mm diameter culvert at 12+075 to address stream flow and sediment transport down the stream. • Expect an increased level of maintenance along this section of the alignment with seasonal ditchline cleaning likely required. Cut: 100% in imperfectly drained till deposits. Fill: 70% for fill of local material.		
12+130 452112 6206323 **Sec. 1-HHH**	**12+240** 452126 6206210	20-35%	The proposed alignment continues to track the existing road. The existing road prism is in relatively good condition aside from a minor road washout at the stream location. Cross a small stream at 12+200 which has washed out the road prism. The stream flows down the ditchline of the road from 12+260. Surficial materials consist of deep deposits of imperfect to moderately well drained silty sand with some gravel till deposits.		>3m	Imperfect to Mod. Well	**Moderate:** Another washout on the road if the stream at 12+200 is not restored to the natural location. Entrainment of the road prism material and transport of minor sediment volumes to Bitter Creek.	Sediment delivery to Bitter Creek. **Moderate**	**Moderate**	• Upgrade the road by cleaning off the road prism and ditchlines. • Widen the alignment as needed using cut and fill methods. • Repair the washout at 12+200 by importing granular material to fill in the washout and reroute the stream back to the original location at 12+260. Cut: 100% in imperfectly drained till deposits. Fill: 70% for fill of local material.	**Low**	**Low**
12+240 452126 6206210 **Sec. 1-III**	**12+800** 452225 6205675	20-45%	The proposed alignment continues to track the existing road. The road is situated downslope of a large failing slope composed of till deposits. Numerous small landslide and debris flow events have originated in the till slope and have ranout at the road location. Due to these numerous landslide and debris flow events impinging on the road alignment, the existing road is in poor condition. In most locations the running surface is buried by debris and the road prism is saturated. Restoring the road to a condition where industrial traffic is possible will be a significant undertaking similar in magnitude to constructing a new road section. Cross a series of streams with associated debris flow or small slide deposits at the following locations: • 12+260 – Large stream with associated debris flow deposit. • 12+345 – Small stream with minor debris transport with an infilled 600mm culvert. • 12+390 – Small stream with minor debris deposit. • 12+470 – Large stream with tufa deposits		>3m	Poor	**High:** Continued natural landslide and debris flow activity originating in the till slope upslope of the road location. Ongoing runout to the road location.	Sediment delivery to Bitter Creek. **Low** Chronic loss of access on the proposed road alignment. Frequent maintenance required. **Moderate**	**Moderate** **High**	• Upgrade the road by cleaning off the road prism and ditchlines. • Upgrade the road ditchline to 4m wide by 1m deep to capture landslide and debris flow events impinging on the road location. • Clean and maintain the ditchline of the road on a seasonal basis or more frequently if needed. • Widen the alignment as needed using cut and fill methods. • Install 800mm diameter culverts at the following locations to address stream flow: o 12+260 o 12+390 o 12+470 o 12+730 • Install 600mm diameter culverts at the following locations to address stream flow: o 12+345 o 12+550 o 12+630 o 12+770	**High –** Continued natural landslide activity	**Low** **Mod.**

Table 6.1: Red Mountain Gold Mine Access Route Section 1 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
			indicating ground water origin and minor debris deposits. • 12+550 – Small stream with a recent debris deposit on the road. • 12+630 – Small stream with recent debris deposit on the road. • 12+730 – Large stream with large debris deposit on the road. Ongoing deposition but relatively low energy flow deposits. • 12+770 – Two small streams which have eroded through the road prism with minor material deposition. Surficial materials consist of poorly drained silty sand with some gravel till deposits.							Cut: 100% in poorly drained till deposits. Fill: 70% for fill of local material.		
12+800 452225 6205675 **Sec. 1-JJJ**	**12+980** 452223 6205496	0-45%	The proposed road pulls away from the failing till slope and traverses bedrock controlled terrain. The existing road prism is indistinct and only 3-3.5m wide. Terrain is irregular with gentle to moderate slope gradients. A broad flat gradient depressional area is present downslope of the road location. Surficial materials consist of imperfectly to moderately well drained rubble colluvium in a silty sand matrix.		1-2m	Imperfect to Mod. Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate in the depressional area immediately downslope of the road location.	Sediment delivery to Bitter Creek. **Low**	**V. Low**	• Cut and fill construction. Cut: 100% in imperfectly to moderately well drained colluvium deposits. 200% in competent mudstone bedrock. Fill: 70% for fill of local material.	**Low**	**V. Low**
12+980 452223 6205496 **Sec. 1-KKK**	**13+247** 452235 6205235 **POT**	0-20%	The proposed alignment traverses the base of the depressional area. Terrain is irregular with flat to gentle slope gradients. Cross over a small, low gradient stream at 13+050 and 13+160. The stream channel is approximately 1m wide and shows no signs of hydrogeomorphic activity. Surficial materials consist of a veneer of imperfectly to moderately well drained sand and gravel fluvial deposits overlying glacial polished mudstone bedrock.		1-2m	Imperfect to Mod. Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate in the depressional area immediately downslope of the road location.	Sediment delivery to Bitter Creek. **Low**	**V. Low**	• Cut and fill construction. Cut: 70% in imperfectly to moderately well drained fluvial deposits. 200% in competent mudstone bedrock. Fill: 70% for fill of local material.	**Low**	**V. Low**

Table 6.2: Red Mountain Gold Mine Access Route Section 2 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
14+994 452862 6204129 **POC** **Sec. 2-A**	**15+085** 452889 6204044	40-60%	Start the assessment on the north side of Otter Creek where the proposed road emerges from the Tailings Management Facility (TMF). The proposed road traverses irregular, moderate to moderately steep gradient terrain on approach to the crossing over Otter Creek from 15+040 to 15+061. Otter Creek is confined in a small bedrock controlled gorge at the crossing point but loses all confinement and fans out below the crossing point. The channel is composed of cobble to large boulder sized sediments and numerous debris lobes and deposits are present downstream of the crossing point. Otter Creek is a high energy debris flow system and hosts frequent debris flow events. These events appear to be relatively well confined at the crossing location but the crossing design must account for these types of events. Furthermore, an extremely large event on the system has the potential to lead to a major channel avulsion upslope of the crossing location and possible impact to the proposed road alignment. The source of much of the sediment involved in the debris flow activity in Otter Creek appears to be the mid to upper slopes of the watershed which has been recently deglaciated. Orthoimagery of the area indicates that an essentially unlimited supply of unconsolidated morainal deposits is present in the area. This indicates that debris flow events will be an ongoing phenomenon in the system regardless of whether the road is constructed. Bedrock noted at the site consists of glacial polished black mudstone. All of the loose and weathered outer layers of the rock mass have been stripped off by glacial action. Surficial materials consist of a thin veneer of rubble or morainal deposits over bedrock. Deeper debris flow deposits are present downslope of the crossing location.		<0.5m	Mod. Well	**Moderate**: Small (<500m^3) fill slope failure due to fill placement on smooth, glacial polished bedrock. Runout is expected to terminate in or adjacent to Otter Creek where a portion of the material will be entrained and transported downstream to Bitter Creek.	Sediment delivery to Otter Creek. **High**	**High***	• Cut and fill construction with fill constructed out of keyed in angular rock. • Ensure that that all fill material is placed on a natural or chipped bench into the bedrock surface. • Bedrock will be encountered and drill and blast excavation techniques will likely be required. • Install a crossing structure over Otter Creek as per OEL design. Cut: 100% in native surficial materials 200% in competent mudstone bedrock Fill: 85% for fill of keyed in angular rock *Note that while a small fill slope failure could lead to sediment delivery to Otter and Bitter creek, the actual volume of sediment introduced into the creeks by the road will be insignificant compared to the natural sediment loads present. **Note that the frequency of natural debris flow events on Otter Creek will not be reduced by the road construction recommendations. However, the construction recommendations will reduce the impact to elements at risk. In other words the P(H) will remain the same but the P(S:H) will be reduced.	**Low**	**Mod.**
								Sediment delivery to Bitter Creek. **Moderate**	**Moderate***			**Low**
							High: Large debris flow event on Otter Creek impacting the road alignment and crossing structure. A large scale stream avulsion is also possible.	Damage to the crossing structure over Otter Creek. **High**	**V. High**		**High****	**Mod.****
15+085 452889 6204044 **Sec. 2-B**	**15+540** 453098 6203655	20-60%	Terrain is highly irregular and bedrock controlled. The proposed alignment climbs out of the Otter Creek crossing through a series of bedrock knobs and ridges. While the irregularity and slope gradient of the terrain is conducive to fill placement, the constraints of the road grade and surrounding topography requires that much of this section of the road be constructed with ¾ to full bench cut techniques. Bedrock noted at the site consists of glacial polished black mudstone. All of the loose and weathered outer layers of the rock mass have been stripped off by glacial		0-0.5m	Well	**Moderate**: Small (<500m^3) fill slope failure due to fill placement on smooth, glacial polished bedrock. Runout is expected to terminate on benched terrain within 50m of the road location.	Sediment delivery to Bitter Creek. **Low**	**Low**	• Cut and fill construction is possible due to slope gradients and surface irregularity; however, ¾ to full bench cut is required due to vertical alignment constraints. • Ensure that that all fill material is placed on a natural or chipped bench into the bedrock surface. • Excess material can be spoiled along the bedrock promontory downslope of the proposed road location from 15+340 to 15+470. • Bedrock will be encountered and drill and blast excavation techniques will likely be required.	**Low**	**V. Low**

Table 6.2: Red Mountain Gold Mine Access Route Section 2 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
			action. Fill placement on this type of rock surface can be challenging due to the polished nature of the rock surface. As a result fills will need to be placed on natural or chipped bench features in the rock mass. A small sand and gravel deposit was noted on the bench above 15+360. Minor flow may be present in this location during the spring freshet. Surficial materials consist of isolated skiffs and lenses of rubble colluvium in topographic lows. It is expected that the majority of this material will be removed during stripping activities and the road prism will be constructed out of blast rock.							• Install a 600mm diameter culvert at 15+360 to address surface flow during the spring freshet period. Cut:200% in competent mudstone bedrock Fill: 70% for sidecast shot rock 85% for fill of keyed in angular rock		
15+540 453098 6203655 **Sec. 2-C**	**15+635** 453126 6203660	10-20% at the switchback 50-60% upslope of the switchback	The road turns a switchback on a broad flat to gentle gradient bench. The bench is bedrock controlled with numerous bedrock outcrops at surface. Terrain upslope of the upper leg of the switchback kicks up into moderately steep gradient, bedrock controlled terrain. Construction of the switchback will required a large cut in bedrock along the upper leg. Surficial materials consist of isolated skiffs and lenses of rubble colluvium in topographic lows. It is expected that the majority of this material will be removed during stripping activities and the road prism will be constructed out of blast rock.		0-0.5m	Well	**Moderate:** Small scale (<1m^3) rock detachment from the large bedrock cut along the upper leg of the switchback. Runout is expected to terminate on the proposed road.	Hazard to road users or road construction workers. **Moderate**	**Moderate**	• Cut and fill construction around the lower leg of the switchback transitioning into full bench cut along the upper leg. • Excess material generated during construction can be spoiled in the gentle gradient area between the upper and low legs of the switchback. • Scale the rock cut along the upper leg of the switchback to remove all loose hazardous blocks during and following the completion of construction activities. Cut:200% in competent mudstone bedrock Fill: 70% for sidecast shot rock 85% for fill of keyed in angular rock	**Low**	**Low**
15+635 453126 6203660 **Sec. 2-D**	**15+675** 453116 6203701	20-40% at the road location 70-80% above the road	The road alignment tracks the base of a steep, bedrock controlled slope. Benched, gentle to moderate gradient terrain is present at and downslope of the road location. Surficial materials consist of a thin veneer of rubble colluvium overlying bedrock. It is expected that the majority of this material will be removed during stripping activities and the road prism will be constructed out of blast rock.		0.5m	Well	**Moderate**: Small (<500m^3) fill slope failure due to fill placement on smooth, glacial polished bedrock. Runout is expected to terminate on benched terrain immediately downslope of the road location.	Sediment delivery to Bitter Creek. **Low**	**Low**	• Cut and fill construction. • Ensure that that all fill material is placed on a natural or chipped bench into the bedrock surface. Cut:200% in competent mudstone bedrock Fill: 70% for sidecast shot rock 85% for fill of keyed in angular rock	**Low**	**V. Low**
15+675 453116 6203701 **Sec. 2-E**	**15+715** 453105 6203738	65-75% at the road location Benches to 20-30% approximately 25m downslope	The bench that the road was previously tracking falls away and the road traverses moderately steep to steep gradient terrain. A large talus field is present at the road location and is composed of sub angular clasts generally 1-2m in diameter. Construction through this area is expected to result in a large rock cut. Surficial materials consist of a veneer to thin blanket of coarse angular talus overlying bedrock.		1m	Rapid	**Moderate:** Small scale (<1m^3) rock detachment from the large bedrock cut along this road section. Runout is expected to terminate on the proposed road.	Hazard to road users or road construction workers. **Moderate**	**Moderate**	• **Full bench cut construction.** • Endhaul all excess material to a suitable waste site. Suitable waste sites are present at the centre of the preceding switchback and from 15+340 to 15+470. • Scale the rock cut along the road section during and following the completion of construction activities. • Make construction workers aware of the potential for the talus material to ravel and slough during road construction. Ensure that any perched lobes of material at the top of the road cut are removed	**Low**	**Low**
							Moderate: Small sloughing and raveling in the talus material during road construction. Runout is expected to terminate on the	Hazard to road users or road construction workers. **Moderate**	**Moderate**		**Low**	**Low**

Table 6.2: Red Mountain Gold Mine Access Route Section 2 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
							road alignment or on the benched terrain immediately downslope	Sediment delivery to Bitter Creek. **Low**	**Low**	during construction works. Cut: 100% in rapidly drained angular talus material 200% in competent mudstone bedrock Fill: N/A – Endhaul all generated material		**V. Low**
							High: Small (<500m^3) fill slope failure due to fill placement on moderately steep to steep gradient terrain. Runout is expected to terminate on benched terrain within 100m downslope of the road location	Sediment delivery to Bitter Creek. **Low**	**Moderate**		**Low**	**V. Low**
15+715 453105 6203738 **Sec. 2-F**	**15+810** 453107 6203829	70-80% at the road location 10-30% immediately downslope	A gentle gradient bench is present immediately downslope of the road location. The road itself is situated on steep gradient terrain but fill placement extending down to the bench is considered feasible. Cross a small debris deposit at 15+775 which appears to be associated with an ephemeral stream. Construction through this area is expected to result in a large rock cut. Surficial materials consist of a thin veneer of rubble colluvium overlying bedrock. It is expected that the majority of this material will be removed during stripping activities and the road prism will be constructed out of blast rock.		0-0.5m	Well	**Moderate**: Small (<500m^3) fill slope failure due to fill placement on smooth, glacial polished bedrock. Runout is expected to terminate on benched terrain immediately downslope of the road location.	Sediment delivery to Bitter Creek. **Low**	**Low**	• Cut and fill construction with large fill extending down to the underlying bench. • Ensure that that all fill material is placed on a natural or chipped bench into the bedrock surface. • Scale the rock cut along the road section during and following the completion of construction activities. • Install a 600mm diameter culvert at 15+775 to address ephemeral stream flow. • Install a large sump at the culvert inlet to allow for minor debris movement and infilling. Cut:200% in competent mudstone bedrock Fill: 70% for sidecast shot rock 85% for fill of keyed in angular rock	**Low**	**V. Low**
							Moderate: Small scale (<1m^3) rock detachment from the large bedrock cut along this road section. Runout is expected to terminate on the proposed road.	Hazard to road users or road construction workers. **Moderate**	**Moderate**		**Low**	**Low**
15+810 453107 6203829 **Sec. 2-G**	**15+900** 453094 6203917	65-75% at the road location Benches to 30-40% approximately 40m downslope	The alignment climbs through irregular, bedrock controlled, moderately steep to steep gradient terrain. Moderate gradient, benched terrain is present approximately 40m downslope of the road location. Construction through this area is expected to result in a large rock cut. Surficial materials consist of a thin veneer of rubble colluvium overlying bedrock. It is expected that the majority of this material will be removed during stripping activities and the road prism will be constructed out of blast rock.		0-0.5m	Mod. Well to Well	**High:** Small (<500m^3) fill slope failure due to fill placement on moderately steep to steep gradient terrain. Runout is expected to terminate on benched terrain within 100m downslope of the road location	Sediment delivery to Bitter Creek. **Low**	**Moderate**	• **Full bench cut construction.** • Shift to ¾ bench cut construction with fill constructed out of keyed in angular where downslope surface irregularity allows for fill placement. • Endhaul all excess material to a suitable waste site. Suitable waste sites are present at the centre of the preceding switchback and from 15+340 to 15+470. • Scale the rock cut along the road section during and following the completion of construction activities. Cut: 200% in competent mudstone bedrock Fill: 85% for fill of keyed in angular rock	**Low**	**V. Low**
							Moderate: Small scale (<1m^3) rock detachment from the large bedrock cut along this road section. Runout is expected to terminate on the proposed road.	Hazard to road users or road construction workers. **Moderate**	**Moderate**		**Low**	**Low**
15+900 453094 6203917 **Sec. 2-H**	**16+045** 453099 6204061	20-50%	Terrain is irregular and bedrock controlled with gentle to moderate slope gradients. Surficial materials consist of a thin veneer of rubble colluvium overlying bedrock. It is expected that the majority of this material will be removed during stripping activities and the road prism will be constructed out of blast rock.		0-0.5m	Imperfect to Mod. Well	**Moderate**: Small (<500m^3) fill slope failure due to fill placement on smooth, glacial polished bedrock. Runout is expected to terminate on benched terrain immediately downslope of the road	Sediment delivery to Bitter Creek. **Low**	**Low**	• Cut and fill construction with large fill extending down to the underlying bench. • Ensure that that all fill material is placed on a natural or chipped bench into the bedrock surface. Cut:200% in competent mudstone bedrock Fill: 70% for sidecast shot rock	**Low**	**V. Low**

Table 6.2: Red Mountain Gold Mine Access Route Section 2 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
							location.			85% for fill of keyed in angular rock		
16+045 453099 6204061 **Sec. 2-I**	**16+110** 453095 6204128	20-40%	The alignment traverses the toe of a steep gradient, failing slope. The failing slope appears to be composed of poorly consolidated morainal deposits which are oversteepened with respect to the natural angle of repose for the material. The failures appear to be a natural response to the oversteepened slope angle. The road crosses the depositional zone of this failing slope where slope gradients moderate. A small debris flow deposit is also present at 16+075. Surficial materials consisting of a blanket of imperfect to moderately well drained rubble colluvium in a silty sand matrix.		2m	Imperfect to Mod. Well	**Moderate:** Further natural landslide activity on the slope above the proposed alignment. Runout is expected to terminate on or immediately upslope of the proposed road.	Hazard to road users or road construction workers. **Moderate**	**Moderate**	• Cut and fill construction. • Install an oversized (minimum of 2m wide at the base) ditchline to capture small scale landslide events impinging on the alignment. • Install a 600mm diameter culvert at 16+075 to address ephemeral flow at the debris flow deposit. • Install a large sump at the culvert inlet to allow for minor debris movement and infilling. Cut: 100% in imperfectly to moderately well drained colluvium deposits. 200% in competent mudstone bedrock Fill: 70% for fill of local material.	**Mod.**	**Low**
								Chronic maintenance concern with seasonal impact to the road alignment. **Moderate**	**Moderate**			**Low**
16+110 453095 6204128 **Sec. 2-J**	**16+280** 453129 6204139	20-35% on the lower leg of the switchback 60-70% on the upper leg of the switchback	The alignment turns a switchback on a broad bench approximately 20m southeast of Otter Creek. The upper leg of the switchback climbs up onto moderately steep gradient terrain. The bench feature has the morphology of a remnant of a dissected fan and is composed of deeper surficial materials. The slope that the upper leg of the switchback climbs up onto is bedrock controlled. As was described in the section of the road table concerning the crossing over Otter Creek, the creek is a high energy system that hosts frequent debris flow events. It is possible that a high magnitude debris flow event on Otter Creek could lead to an avulsion which could impact the proposed road. Surficial materials consisting of a blanket of imperfect to moderately well drained rubble colluvium in a silty sand matrix along the lower leg of the switchback. A thin veneer of rubble colluvium overlies bedrock along the upper leg of the switchback.		2-3m on the lower leg 0-0.5m on the upper leg	Imperfect to Mod. Well	**Moderate**: Large natural debris flow event on Otter Creek leading to an avulsion and impact to the proposed switchback.	Temporary loss of access on the proposed road alignment. **Moderate**	**Moderate**	• Cut and fill construction transitioning into full bench cut along the upper leg of the switchback due to vertical alignment constraints. • Construct the lower leg of the switchback out of angular rock generated during construction of the upper leg and upchain road sections. The resulting road will be resistant to erosion in the event of an avulsion on Otter Creek. • Scale the rock cut along the upper leg of the switchback during and following the completion of construction activities. Cut: 100% in imperfectly to moderately well drained colluvium deposits. 200% in competent mudstone bedrock Fill: 70% for fill of local material. *Note that the frequency of natural debris flow events on Otter Creek will not be reduced by the road construction recommendations. However, the construction recommendations will reduce the impact to elements at risk. In other words the P(H) will remain the same but the P(S:H) will be reduced.	**Mod.***	**Low**
								Sediment delivery to Otter Creek **High**	**High**			**Low**
								Sediment delivery to Bitter Creek. **Moderate**	**Moderate**			**Low**
							Moderate: Small scale (<1m^3) rock detachment from the large bedrock cut along this road section. Runout is expected to terminate on the proposed road.	Hazard to road users or road construction workers. **Moderate**	**Moderate**		**Low**	**Low**
16+280 453129 6204139 **Sec. 2-K**	**16+390** 453170 6204038	70-90% above the alignment 40-50% below the alignment	The alignment traverses a series of open slope failures. Terrain is irregular with steep slope gradients above the alignment and moderate slope gradients below the alignment. The failures appear to have occurred where a veneer to thin blanket of morainal material overlies weak bedrock. The failures mainly appear to have occurred at the interface of the morainal material and the rock but do extend slightly into the upper weathered layers of the road mass. The moderate gradient slopes below the alignment are		0.5-2m	Imperfect	**Moderate:** Mid-sized (<1000m^3) fill slope failure due to fill placement on unconsolidated landslide deposits. Runout is expected to terminate on gentle to moderate gradient benched terrain within 100m downslope.	Sediment delivery to Otter Creek **Low**	**Low**	• **Full bench cut construction.** • Endhaul all excess material to a suitable waste site. Suitable waste sites are present on the benched terrain downslope of the proposed road from 15+955 to 16+110. • Scale the rock cut along the road section during and following the completion of construction activities. • Make construction workers aware of the potential for the surficial material to ravel and slough during road construction. Ensure that any perched lobes of	**Low**	**V. Low**
								Sediment delivery to Bitter Creek. **Low**	**Low**			**V. Low**
							Moderate: Small scale (<1m^3) rock detachment from the	Hazard to road users or road	**Moderate**		**Low**	**Low**

Table 6.2: Red Mountain Gold Mine Access Route Section 2 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
			primarily made up of deposits from the open slope failures and as a result is unconsolidated. Filling down onto the depositional area has the potential to load the slope, leading to a subsequent fillslope failure. Surficial materials consist of a veneer to thin blanket of poorly consolidated morainal deposits and weathered bedrock. This material is underlain by weak, somewhat metamorphosed mudstone.				large bedrock cut along this road section. Runout is expected to terminate on the proposed road.	construction workers. **Moderate**		material at the top of the road cut are removed during construction works. Cut: 100% in imperfectly to moderately well drained colluvium deposits. 200% in competent mudstone bedrock Fill: 70% for fill of local material.		
							Moderate: Retrogressing cutslope failure in the veneer of material overlying local bedrock. Runout is expected to terminate on the proposed road alignment.	Hazard to road users or road construction workers. **Moderate**	**Moderate**		**Low**	**Low**
								Chronic maintenance concern with frequent blockage of the road alignment. **Moderate**	**Moderate**			**Low**
16+390 453170 6204038 **Sec. 2-L**	**16+750** 453283 6203721	40-200%	The alignment climbs through highly irregular, bedrock controlled terrain. Slope gradients are variable and moderate to vertical slope gradients are present. Bedrock noted at the site consists of glacial polished black mudstone. All of the loose and weathered outer layers of the rock mass have been stripped off by glacial action. Construction through this area is expected to result in a large rock cut. Cross a bedrock controlled stream draw at 16+735. The stream channel is approximately 2m wide and composed of water polished bedrock. The stream was dry at the time of fieldwork but appears to carry substantial flow volume during the spring freshet period. Surficial materials consist of a thin veneer of rubble colluvium overlying bedrock. It is expected that the majority of this material will be removed during stripping activities and the road prism will be constructed out of blast rock.		0-0.5m	Mod. Well	**High:** Mid-sized (<1000m^3) fill slope failure due to fill placement on steep gradient bedrock controlled slopes. Runout is expected to terminate on gentle to moderate gradient benched terrain within 100m downslope.	Sediment delivery to Bitter Creek. **Low**	**Moderate**	• **Full bench cut construction.** • Shift to ¾ bench cut construction with fill composed of keyed in angular rock where sufficient surface irregularity allows for fill placement. • Ensure that that all fill material is placed on a natural or chipped bench into the bedrock surface. • Endhaul all excess material to a suitable waste site. Suitable waste sites are present on the benched terrain downslope of the proposed road from 15+955 to 16+110. • Scale the rock cut along the road section during and following the completion of construction activities. • Install a 1000mm diameter culvert to address stream flow. Ensure the culvert and all associated fill is founded on a bench chipped or blasted into the bedrock substrate of the channel. Cut: 200% in competent mudstone bedrock Fill: 85% for fill of keyed in angular rock	**Low**	**V. Low**
							Moderate: Small scale (<1m^3) rock detachment from the large bedrock cut along this road section. Runout is expected to terminate on the proposed road.	Hazard to road users or road construction workers. **Moderate**	**Moderate**		**Low**	**Low**
16+750 453283 6203721 **Sec. 2-M**	**16+885** 453335 6203681	10-20% at the road location >100% immediately downslope	The alignment crests over onto a large bedrock bench and traverses the crest of a sharp slope break to bedrock bluffs. Slope gradients are gentle at the road location but break over to very steep immediately downslope. Surficial materials consist of a thin veneer of rubble colluvium overlying bedrock. It is expected that the majority of this material will be removed during stripping activities and the road prism will be constructed out of blast rock.		0-0.5m	Well	**High:** Mid-sized (<1000m^3) fill slope failure due to fill placement on steep gradient bedrock controlled slopes below the alignment. Runout is expected to terminate on gentle to moderate gradient benched terrain approximately 100m downslope.	Sediment delivery to Bitter Creek. **Low**	**Moderate**	• **Full bench cut construction.** • Endhaul all excess material to a suitable waste site. Suitable waste sites are present on the benched terrain downslope of the proposed road from 15+955 to 16+110. Cut: 200% in competent mudstone bedrock Fill: N/A – Endhaul all excess material	**Low**	**V. Low**

Table 6.2: Red Mountain Gold Mine Access Route Section 2 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
16+885 453335 6203681 **Sec. 2-N**	**17+040** 453410 6203670	10-20%	The alignment turns a switchback on a large, gentle gradient bedrock bench. A high energy stream is crossed by the alignment at 16+925 and 17+000. The stream flows out of a steep bedrock controlled draw approximately 40m upslope of the upper crossing location and has fanned out over the bench feature. Signs of debris flow activity such as debris lobes and levees are present in this location. These debris flow events appear to occur relatively frequently. Surficial materials consist of a veneer to thin blanket of rubble colluvium or debris flow deposits overlying bedrock.		0-1m	Imperfect to Mod. Well	**Moderate:** Debris flow event impinges on the alignment and blocks the drainage structure at the crossing site. Washout of the road prism and entrainment of a portion of the road material in the stream.	Temporary loss of access on the proposed road and damage to the drainage structure. **Moderate**	**Moderate**	• Full fill construction transitioning into cut and fill construction around the upper leg of the switchback. • Install 1000mm diameter culverts at the crossing points over the stream at 16+925 and 17+000. • Install large sumps at the culvert inlets and clean out the sumps as needed. Constructed the road prism out of angular rock at the crossing locations. Cut: 100% in imperfectly to moderately well drained colluvium deposits. 200% in competent mudstone bedrock Fill: 70% for fill of sidecast local material. 85% for fill of keyed in angular rock.	**Low**	**Low**
								Sediment delivery to Bitter Creek. **Low**	**Low**			**V. Low**
17+040 453410 6203670 **Sec. 2-O**	**17+105** 453454 6203627	50-60% at the road location 70-80% downslope	The alignment traverses moderately steep gradient planar to benched terrain upslope of a prominent landslide headscarp. The landslide headscarp is situated 20-30m downslope of the road location. The headscarp is approximately 10m tall and extends for 120m downslope. The slide track is unvegetated which suggests that continued raveling and sloughing is occurring. The slide may have initially occurred from changes in drainage patterns on the fan which the road crossing in the preceding section which led to drainage concentration onto the slope. The road is situated far enough back from the crest of the headscarp that it is unlikely that the slide headscarp could retrogress back to the road location, particularly since the area separating the landslide and the road is likely bedrock controlled. However, drainage concentration to the landslide area is possible if natural drainage patterns in the area are disrupted by road construction. This has the potential to lead to further landslide activity. Cross a small stream at 17+055. The stream channel is <1m wide and appears to carry minimal flow. Surficial materials consist of a blanket of imperfectly drained gravelly sand with some silt morainal deposits.		1-2m	Imperfect	**Moderate:** Drainage pattern disruption along the proposed road alignment leading to drainage concentration onto the existing landslide headscarp downslope. Initiation of a mid-sized (<1000m^3) failure running out in the existing landslide track.	Sediment delivery to Bitter Creek. **Moderate**	**Moderate**	• **Full bench cut construction.** • Shift to ¾ bench cut construction with fill composed of keyed in angular rock where sufficient surface irregularity allows for fill placement. • Endhaul all excess material to a suitable waste site. Suitable waste sites are present in the centres of the preceding two switchbacks. • Install a 600mm diameter culvert at 17+055 to address stream flow. Cut: 100% in imperfectly drained morainal deposits 200% in competent mudstone bedrock Fill: 85% for fill of keyed in angular rock	**Low**	**Low**
							Moderate: Mid-sized (<1000m^3) fill slope failure due to fill placement on moderately steep gradient slopes. The slide is expected to enter the existing landslide track downslope and runout within the existing landslide track.	Sediment delivery to Bitter Creek. **Moderate**	**Moderate**		**Low**	**Low**
17+105 453454 6203627 **Sec. 2-P**	**17+250** 453534 6203510	10-40%	The alignment traverses planar to benched terrain with gentle to moderate slope gradients. The benched terrain appears to be the product of a series of lateral moraines deposited as glacial ice receded in the valley. Cross a small imperfectly drained area at 17+130. Subsurface flow may be encountered at this location. Surficial materials consist of a blanket of imperfectly to well drained gravelly sand with trace silt morainal		2-3m	Imperfect to Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on moderate gradient, benched terrain immediately downslope of the road location.	**N/A**	**N/A**	• Cut and fill construction. • Install a 600mm diameter cross drain at 17+130 to address possible subsurface flow. Cut: 100% in imperfectly to well drained morainal deposits Fill: 70% for fill of sidecast local material.	**Low**	**N/A**

Table 6.2: Red Mountain Gold Mine Access Route Section 2 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
			deposits.									
17+250 453534 6203510 **Sec. 2-Q**	**17+315** 453565 6203452	30-50% above the alignment 60-75% below the alignment	The bench that the alignment tracks fades out and the alignment climbs through moderate gradient terrain directly upslope of a slope break to moderately steep to steep gradient gullied terrain. The area appears to be well drained; however, the gullied terrain downslope of the road is expected to be susceptible to drainage concentration related landslide activity. Surficial materials consist of a blanket of well drained gravelly sand with trace silt morainal deposits.		2-3m	Well	**Moderate:** Large (>1000m^3) fill slope failure due to fill placement extending onto moderately steep to steep gradient terrain immediately downslope of the road location. Runout is expected to terminate on moderate gradient terrain approximately 300m downslope. Direct impact to Bitter Creek is not expected but fine sediment delivery may occur.	Sediment delivery to Bitter Creek. **Moderate**	**Moderate**	• **Full bench cut construction.** • Shift to ¾ bench cut construction with fill composed of keyed in angular rock where sufficient surface irregularity allows for fill placement. • Endhaul all excess material to a suitable waste site. Suitable waste sites are present in the centres of the preceding two switchbacks. • **Attention must be paid to drainage measures along this section of the alignment.** Ensure that cross drain culverts are installed at all natural drainage locations and points where subsurface flow is encountered. Cut: 100% in well drained morainal deposits Fill: 85% for fill of keyed in angular rock	**Low**	**Low**
							Moderate: Large (>1000m^3) translational landslide on the gullied terrain downslope of the road alignment due to drainage concentration along the road. Runout is expected to terminate on moderate gradient terrain approximately 300m downslope. Direct impact to Bitter Creek is not expected but fine sediment delivery may occur.	Sediment delivery to Bitter Creek. **Moderate**	**Moderate**		**Low**	**Low**
17+315 453565 6203452 **Sec. 2-R**	**17+365** 453587 6203410	20-30% at the road location 45-55% above the alignment >100% below the alignment	The alignment tracks a broad gentle gradient bench feature. Downslope of the bench terrain breaks over into a series of very steep landslide scarps. Moderately steep gradient planar to somewhat irregular terrain is present upslope of the road location. The road is situated far enough upslope from the landslide scarps that retrogression of the scarps to the road location is not expected. Furthermore, the bench that the road is situated on is likely bedrock controlled at depth. The primary concern with respect to slope stability is with the potential for Surficial materials consist of a blanket of well drained gravelly sand with trace silt morainal deposits.		2-3m	Well	**Moderate:** Large (>1000m^3) translational landslide on the gullied terrain downslope of the road alignment due to drainage concentration along the road. Runout is expected to terminate on moderate gradient terrain approximately 300m downslope. Direct impact to Bitter Creek is not expected but fine sediment delivery may occur.	Sediment delivery to Bitter Creek. **Moderate**	**Moderate**	• Cut and fill construction. • **Attention must be paid to drainage measures along this section of the alignment.** Ensure that cross drain culverts are installed at all natural drainage locations and points where subsurface flow is encountered. Cut: 100% in well drained morainal deposits Fill: 70% for fill of sidecast local material.	**Low**	**Low**
17+365 453587 6203410 **Sec. 2-S**	**17+450** 453639 6203342	50-70%	The bench that the alignment was tracking fades out and the alignment traverses moderately steep gradient, planar to somewhat irregular terrain. Surficial materials consist of a blanket of well drained gravelly sand with trace silt morainal deposits.		2-3m	Well	**Moderate:** Large (>1000m^3) fill slope failure due to fill placement extending onto moderately steep to steep gradient terrain immediately downslope of the road location. Runout is expected to terminate on moderate	Sediment delivery to Bitter Creek. **Moderate**	**Moderate**	• **Full bench cut construction.** • Shift to ¾ bench cut construction with fill composed of keyed in angular rock where sufficient surface irregularity allows for fill placement. • Endhaul all excess material to a suitable waste site. Suitable waste sites are present in the centres of the preceding two switchbacks.	**Low**	**Low**

Table 6.2: Red Mountain Gold Mine Access Route Section 2 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
							gradient terrain approximately 300m downslope. Direct impact to Bitter Creek is not expected but fine sediment delivery may occur.			• **Attention must be paid to drainage measures along this section of the alignment.** Ensure that cross drain culverts are installed at all natural drainage locations and points where subsurface flow is encountered.		
							Moderate: Large (>1000m^3) translational landslide on the gullied terrain downslope of the road alignment due to drainage concentration along the road. Runout is expected to terminate on moderate gradient terrain approximately 300m downslope. Direct impact to Bitter Creek is not expected but fine sediment delivery may occur.	Sediment delivery to Bitter Creek. **Moderate**	**Moderate**	Cut: 100% in well drained morainal deposits Fill: 85% for fill of keyed in angular rock	**Low**	**Low**
17+450 453639 6203342 **Sec. 2-T**	**17+570** 453722 6203255	10-40%	Terrain is benched to somewhat irregular with gentle to moderate slope gradients. Cross a small wet area at 17+500. Shallow subsurface flows are possible in this area. Surficial materials consist of a veneer of angular talus overlying gravelly sand with trace silt morainal deposits.		2-3m	Imperfect to Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on moderate gradient, benched terrain immediately downslope of the road location.	**N/A**	**N/A**	• Cut and fill construction. • Install a 600mm diameter culvert at 17+500 to address potential shallow subsurface flows. Cut: 100% in imperfectly to well drained morainal deposits Fill: 70% for fill of sidecast local material.	**Low**	**N/A**
17+570 453722 6203255 **Sec. 2-U**	**17+650** 453743 6203181	20-60%	The alignment crosses over the Rio Blanco Creek draw. The high water marks of the stream channel are situated at 17+607 and 17+619. The Rio Blanco Creek appears to be a relatively high energy stream with substantial flow at the time of fieldwork and signs of significant scour and downcutting on the sidewall slopes. A number of very large boulders are present in the stream channel and in the surrounding area. The boulders are up to the size of a vehicle and appear to have been transported to site by glacial or snow avalanche activity. The boulders are of sufficient size that they are unlikely to be moved by streamflow. However, care will need to be taken during construction to ensure the boulders in the area are not dislodged or destabilized by excavation works. Boulders that will be impacted by excavation works must be removed from the site via blasting. The Rio Blanco draw appears to host snow avalanche activity during the winter season. As a result, impact to the alignment is considered possible by a snow avalanche event. Surficial materials consist of deep deposits of moderately		>5m	Mod. Well to Well	**Moderate:** Boulder dislodgement during construction works. Runout is expected to terminate on the proposed road alignment.	Hazard to road users or road construction workers. **Moderate**	**Moderate**	• Full bench cut construction on approach and exist to the crossing due to vertical alignment. • Remove all boulders which will be impacted by excavation works via blasting. • Install a crossing structure over Rio Blanco Creek as per OEL design. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: 100% in native surficial materials Fill: N/A – Full bench cut construction	**Low**	**Low**
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**		**Low**	**Low**

Table 6.2: Red Mountain Gold Mine Access Route Section 2 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
			well to well drained gravelly sand with trace to some silt morainal materials. This material is overlain by a veneer of angular talus.									
17+650 453743 6203181 **Sec. 2-V**	**18+005** 453810 6202856	30-50%	The alignment traverses somewhat irregular and benched terrain with moderate slope gradients. Several very large boulders are scattered throughout the area. The boulders are embedded in local surficial material and as a result appear to have been transported to site by glacial action. The area appears to host snow avalanche activity during the winter season. As a result, impact to the alignment is considered possible by a snow avalanche event. Surficial materials consist of a veneer of angular talus overlying deeper gravelly sand with trace to some silt morainal deposits.		>5m	Mod. Well to Well	**High:** Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**	• Cut and fill construction. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: 100% in moderately well to well drained morainal and talus deposits Fill: 70% for fill of sidecast local material.	**Low**	**Low**
18+005 453810 6202856 **Sec. 2-W**	**18+145** 453831 6202725	60-80%	The alignment drops down through moderately steep to steep gradient irregular terrain. Cross over a mid-sized stream in an incised rock controlled draw at 18+135. The stream channel is approximately 1m wide and has a bedrock substrate. Bedrock noted at the stream draw consisted of weak, heavily fractured metavolcanic rock. Surficial materials consist of a veneer to thin blanket of rubble colluvium overlying bedrock.		0-2m	Mod. Well	**Moderate:** Small (<500m^3) fill slope failure due to fill placement on moderately steep gradient slopes. Runout is expected to terminate on moderate gradient benched terrain 50-100m downslope.	Sediment delivery to Bitter Creek. **Low**	**Low**	• **¾ Bench Cut construction with fill composed of keyed in angular rock founded on a natural or excavated bench.** • Shift to Full Bench Cut construction if sufficient rock or surface irregularity is not present for placement of a keyed in rock fill. • Endhaul excess material to a suitable waste site. Suitable waste sites are present from 17+775 to 17+945 along the proposed alignment. Cut: 100% in well drained colluvium deposits. 200% in metavolcanic bedrock. Fill: 85% for fill of keyed in angular rock	**Low**	**V. Low**
18+145 453831 6202725 **Sec. 2-X**	**18+220** 453820 6202647	45-60%	The alignment climbs out of the stream crossing through a moderate to moderately steep gradient irregular slope. Surficial materials consist of a veneer to thin blanket of rubble colluvium overlying bedrock.		1m	Mod. Well	**Moderate:** Small (<500m^3) fill slope failure due to fill placement on moderately steep gradient slopes. Runout is expected to terminate on moderate gradient benched terrain 50-100m downslope.	Sediment delivery to Bitter Creek. **Low**	**Low**	• **¾ Bench Cut construction with fill composed of keyed in angular rock founded on a natural or excavated bench.** • Shift to Full Bench Cut construction if sufficient rock or surface irregularity is not present for placement of a keyed in rock fill. • Endhaul excess material to a suitable waste site. Suitable waste sites are present from 17+775 to 17+945 along the proposed alignment. Cut: 100% in well drained colluvium deposits. 200% in metavolcanic bedrock. Fill: 85% for fill of keyed in angular rock	**Low**	**V. Low**
18+220 453820 6202647 **Sec. 2-Y**	**18+325** 453808 6202542	40-60%	The alignment traverses irregular terrain with moderate to moderately steep slope gradients. Surficial materials consist of a veneer to thin blanket of rubble colluvium overlying bedrock.		1m	Mod. Well	**Moderate:** Small (<500m^3) fill slope failure due to fill placement on moderately steep gradient slopes. Runout is expected to terminate on moderate gradient benched	Sediment delivery to Bitter Creek. **Low**	**Low**	• **½ to ¾ Bench Cut construction with fill composed of keyed in angular rock founded on a natural or excavated bench.** • Shift to Full Bench Cut construction if sufficient rock or surface irregularity is not present for placement of	**Low**	**V. Low**

Table 6.2: Red Mountain Gold Mine Access Route Section 2 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
							terrain 50-100m downslope.			a keyed in rock fill. • Endhaul excess material to a suitable waste site. Suitable waste sites are present from 17+775 to 17+945 along the proposed alignment. Cut: 100% in well drained colluvium deposits. 200% in metavolcanic bedrock. Fill: 85% for fill of keyed in angular rock		
18+325 453808 6202542 **Sec. 2-Z**	**19+055** 453822 6022042	10-35%	The alignment climbs onto gentle to moderate gradient irregular to somewhat benched terrain. Cross a large stream at 18+505. The stream channel is approximately 2m wide and has a gravel to cobble substrate. The stream appears to carry substantial flow during the spring freshet period. Cross a second stream at 18+995. The stream channel is 2m wide and is well confined in a small draw feature. Surficial materials consist of moderately well drained gravelly sand with some silt morainal deposits.		1-2m	Mod. Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on gentle gradient terrain immediately downslope of the road location.	Sediment delivery to Bitter Creek. **Low**	**V. Low**	• Cut and fill construction. • Install a 1000mm diameter culvert at 18+505 to address stream flow. • Install a 1000mm diameter culvert at 18+995 to address stream flow. Cut: 100% in moderately well drained colluvium deposits. 200% in metavolcanic bedrock. Fill: 70% for fill of sidecast local material.	**Low**	**V. Low**
19+055 453822 6022042 **Sec. 2-AA**	**19+290** 453970 6202115	30-45%	The alignment traverses moderate gradient irregular to somewhat benched terrain. Cross two small streams at 19+120 and 19+160. The channel widths are generally on the order of 1m wide. Surficial materials consist of moderately well drained gravelly sand with some silt morainal deposits.		1-2m	Mod. Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on gentle gradient terrain immediately downslope of the road location.	Sediment delivery to Bitter Creek. **Low**	**V. Low**	• Cut and fill construction. • Install 800mm diameter culvert at 19+120 and 19+160 to address stream flow. Cut: 100% in moderately well drained colluvium deposits. 200% in metavolcanic bedrock. Fill: 70% for fill of sidecast local material.	**Low**	**V. Low**
19+290 453970 6202115 **Sec. 2-BB**	**20+050** 454079 6201444	10-35%	The alignment climbs onto gentle to moderate gradient irregular to somewhat benched terrain. Cross a stream at 19+485. The stream is well confined in a small swale and has a channel which is 1-2m wide. Surficial materials consist of moderately well drained gravelly sand with some silt morainal deposits.		1-2m	Mod. Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on gentle gradient terrain immediately downslope of the road location.	Sediment delivery to Bitter Creek. **Low**	**V. Low**	• Cut and fill construction. • Install an 800mm diameter culvert at 19+485 to address stream flow. Cut: 100% in moderately well drained colluvium deposits. 200% in metavolcanic bedrock. Fill: 70% for fill of sidecast local material.	**Low**	**V. Low**
20+050 454079 6201444 **Sec. 2-CC**	**20+200** 454131 6201307	0-20%	The alignment traverses flat to gentle gradient terrain upslope of a prominent slope break. While the road is situated well upslope of the slope break it is possible that drainage pattern disruption along the alignment could impact stability in the downslope area. Surficial materials consist of moderately well drained gravelly sand with some silt morainal deposits.		1-2m	Well	**Moderate:** Drainage pattern disruption along the alignment leads to initiation of a large (>1000m^3) landslide on the escarpment slope. Runout is expected to terminate adjacent to Bitter Creek at the base of the slope.	Sediment delivery to Bitter Creek. **Moderate**	**Moderate**	• Cut and fill construction. • **Attention must be paid to drainage measures along this section of the alignment.** Ensure that cross drain culverts are installed at all natural drainage locations and points where subsurface flow is encountered. Cut: 100% in moderately well drained colluvium deposits. 200% in metavolcanic bedrock. Fill: 70% for fill of sidecast local material.	**Low**	**Low**
20+200 454131 6201307 **Sec. 2-DD**	**20+455** 454190 6201500	20-40%	The alignment turns a switchback in a saddle bounded by a prominent bedrock ridge and then climbs up through a series of stepped lateral moraine deposits. The lateral moraine deposits appear to be relatively recent and were likely deposited during the previous		1-2m	Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on benched terrain immediately	**N/A**	**N/A**	• Cut and fill construction. Cut: 70-100% in well drained morainal deposits. Fill: 70% for fill of sidecast local material.	**Low**	**N/A**

Table 6.2: Red Mountain Gold Mine Access Route Section 2 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
			period of glacial advance/retreat during the little ice age from 1400-1700CE. Due to the relatively young age of the deposits they are poorly consolidated. Surficial materials consist of well drained gravelly sand with trace silt morainal deposits.				downslope of the proposed road location.					
20+455 454190 6201500 **Sec. 2-EE**	**20+490** 454185 6201535	50-60%	The alignment climbs off of benched terrain into a short pitch of planar, moderately steep gradient terrain. Surficial materials consist of well drained gravelly sand with trace silt morainal deposits.		1-2m	Well	**Moderate:** Small (<500m^3) fill slope failure due to fill placement on moderately steep gradient slopes. Runout is expected to terminate on gentle gradient benched terrain within 50m downslope.	Sediment delivery to Bitter Creek. **Low**	**Low**	• **¾ Bench Cut construction with fill composed of keyed in angular rock founded on a natural or excavated bench.** • Shift to Full Bench Cut construction if sufficient rock or surface irregularity is not present for placement of a keyed in rock fill. • Endhaul excess material to a suitable waste site. Suitable waste sites are present from 20+290 to 20+420 downslope of the proposed alignment. Cut: 70-100% in well drained morainal deposits. Fill: 85% for fill of keyed in angular rock	**Low**	**V. Low**
20+490 454185 6201535 **Sec. 2-FF**	**20+620** 454232 6201522	20-40% along the lower leg of the switchback 60-75% along the upper leg of the switchback	The alignment tracks a bedrock controlled bench around the lower leg of the switchback and then enters moderately steep to steep gradient planar slopes around the upper leg of the switchback. A series of small bedrock bluffs are present downslope of the lower leg of the switchback. Bedrock was also observed outcropping at the switchback location and consisted of very strong, glacial polished light green metavolcanic rock. The terrain configuration at the switchback location will result in a large cutslope in bedrock along the upper leg of the switchback. Surficial materials consist of a thin veneer of well drained gravelly sand with trace silt morainal deposits overlying glacial polished bedrock.		0-1m	Well	**Moderate:** Mid-sized (<1000m^3) fill slope failure due to fill placement on glacial polished bedrock or on moderately steep gradient slopes. Runout is expected to terminate on gentle gradient benched terrain approximately 60m downslope.	Sediment delivery to Bitter Creek. **Low**	**Low**	• Cut and fill construction along the lower leg of the switchback transitioning into Full bench cut construction around the upper leg of the switchback. • Scale the rock cut along the road section during and following the completion of construction activities. • Ensure that that all fill material is placed on a natural or chipped bench into the bedrock surface. Cut: 70-100% in well drained morainal deposits. 200% in metavolcanic bedrock Fill: 70% for fill of local material 85% for fill of keyed in angular rock	**Low**	**V. Low**
							Moderate: Small scale (<1m^3) rock detachment from the large bedrock cut along this road section. Runout is expected to terminate on the proposed road.	Hazard to road users or road construction workers. **Moderate**	**Moderate**		**Low**	**Low**
20+620 454232 6201522 **Sec. 2-GG**	**20+775** 454279 6201375	10-20% at the road location 50-60% above and below the road	The alignment gains a small lateral moraine bench and tracks the feature to the southeast. The bench gradually expands in size moving upchain along the alignment. Surficial materials consist of well drained gravelly sand with trace silt morainal deposits.		1-2m	Well	**Moderate:** Small (<500m^3) fill slope failure due to fill placement on moderately steep gradient slopes downslope of the bench feature. Runout is expected to terminate on gentle gradient benched terrain approximately 60m downslope	Sediment delivery to Bitter Creek. **Low**	**Low**	• Cut and fill construction. • **Ensure that the fill slope of the road remains on the bench feature**. This may entail shifting into cut or constructing the fill out of keyed in angular rock in isolated locations. Cut: 70-100% in well drained morainal deposits. 200% in metavolcanic bedrock Fill: 70% for fill of local material 85% for fill of keyed in angular rock	**Low**	**V. Low**
20+775 454279 6201375	**20+855** 454326 6201380	30-45%	The alignment turns a switchback on a broad moderate gradient bench and then climbs through bedrock controlled terrain. The terrain configuration at the switchback location will		0-2m	Well	**Moderate:** Small scale (<1m^3) rock detachment from the large bedrock cut along this road section. Runout is	Hazard to road users or road construction workers.	**Moderate**	• Cut and fill construction along the lower leg of the switchback transitioning into Full bench cut construction around the upper leg of the switchback. • Scale the rock cut along the road section during and	**Low**	**Low**

Table 6.2: Red Mountain Gold Mine Access Route Section 2 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
Sec. 2-HH			result in a large cutslope in bedrock along the upper leg of the switchback. Surficial materials consist of a veneer of angular talus overlying gravelly sand with trace silt morainal deposits. Bedrock was noted upslope of the switchback site and as a result it is unlikely that materials exceed 2m in depth at the switchback location.				expected to terminate on the proposed road.	**Moderate**		following the completion of construction activities. Cut: 70-100% in well drained morainal deposits. 200% in metavolcanic bedrock Fill: 70% for fill of local material 85% for fill of keyed in angular rock		
20+855 454326 6201380 **Sec. 2-II**	**20+935** 454323 6201459	50-80%	The alignment climbs through a series of bedrock controlled benches and escarpments with moderately steep to steep gradient slopes. The area is timbered with mature Hm(SxBl) timber suggesting that the area was upslope of the high mark of the Bitter valley glacier during the most recent glacial advance. As a result the soil profile at the site is likely more consolidated then lower in the valley as it is older. Road construction at the site is expected to result in a large bedrock cutslope. Surficial materials consist of a veneer of well drained rubble colluvium overlying bedrock.		0-0.5m	Well	**Moderate:** Small (<500m^3) fill slope failure due to fill placement on moderately steep gradient slopes. Runout is expected to terminate on gentle gradient benched terrain approximately 60m downslope	Sediment delivery to Bitter Creek. **Low**	**Low**	• **Full bench cut construction.** • Shift to ¾ bench cut construction with fill composed of keyed in angular rock where sufficient surface irregularity allows for fill placement. • Endhaul all excess material to a suitable waste site. Suitable waste sites are present from 20+290 to 20+420 downslope of the proposed alignment. • Scale the rock cut along the road section during and following the completion of construction activities. Cut: 200% in metavolcanic bedrock Fill: 85% for fill of keyed in angular rock	**Low**	**Low**
							Moderate: Small scale (<1m^3) rock detachment from the large bedrock cut along this road section. Runout is expected to terminate on the proposed road.	Hazard to road users or road construction workers. **Moderate**	**Moderate**		**Low**	**Low**
20+935 454323 6201459 **Sec. 2-JJ**	**21+170** 454347 6201527	20-60%	Terrain is irregular and benched with gentle to moderately steep gradient slopes. The alignment turns a switchback on a broad gentle gradient bench feature near the end of the road section. Bedrock was noted outcropping along much of the road section and as a result the majority of the road cut and excavated material is expected to consist of rock. Surficial materials consist of a veneer of well drained rubble colluvium overlying bedrock.		0-1.0m	Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on benched terrain immediately downslope of the proposed road location.	**N/A**	**N/A**	• Cut and fill construction. Cut: 200% in metavolcanic bedrock Fill: 70% for fill of sidecast local material. 85% for fill of keyed in angular rock	**Low**	**N/A**
21+170 454347 6201527 **Sec. 2-KK**	**21+320** 454429 6201403	55-80%	Terrain is irregular and benched with moderately steep to steep slope gradients. Surface irregularity appears to be a product of the underling bedrock morphology. Bedrock was noted outcropping along much of the road section and as a result the majority of the road cut and excavated material is expected to consist of rock. Road construction at the site is expected to result in a large bedrock cutslope. Surficial materials consist of a veneer of well drained rubble colluvium overlying bedrock.		0-1.0m	Well	**High:** Mid-sized (<1000m^3) fill slope failure due to fill placement on moderately steep to steep gradient slopes. Runout is expected to terminate on gentle gradient benched terrain approximately 70m downslope	Sediment delivery to Bitter Creek. **Low**	**Moderate**	• **Full bench cut construction.** • Shift to ¾ bench cut construction with fill composed of keyed in angular rock where sufficient surface irregularity allows for fill placement. • Endhaul all excess material to a suitable waste site. Suitable waste sites are present in the centre of the preceding switchback and from 20+290 to 20+420 downslope of the proposed alignment. • Scale the rock cut along the road section during and following the completion of construction activities. Cut: 200% in metavolcanic bedrock Fill: 85% for fill of keyed in angular rock	**Low**	**V. Low**
							Moderate: Small scale (<1m^3) rock detachment from the large bedrock cut along this road section. Runout is expected to terminate on the proposed road.	Hazard to road users or road construction workers. **Moderate**	**Moderate**		**Low**	**Low**
21+320	**21+400**	50-60%	Terrain is planar with moderately steep slope gradients.		1-2m	Well	**Moderate:** Small (<500m^3) fill	Sediment delivery	**Low**	• **½ to ¾ Bench Cut construction with fill composed of**	**Low**	**Low**

Table 6.2: Red Mountain Gold Mine Access Route Section 2 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
454429 6201403 **Sec. 2-LL**	454460 6201333		Bedrock was not noted at surface through this road section and as a result surficial materials are expected to be somewhat deeper than the proceeding sections. Surficial materials consist of a thin blanket of well drained silty sand with some gravel colluvium				slope failure due to fill placement on moderately steep to steep gradient slopes. Runout is expected to terminate on benched terrain approximately 70m downslope.	to Bitter Creek. **Low**		**keyed in angular rock founded on a natural or excavated bench.** • Endhaul all excess material to a suitable waste site. Suitable waste sites are present in the centre of the preceding switchback and from 20+290 to 20+420 downslope of the proposed alignment. Cut: 100% in well drained colluvium deposits 200% in metavolcanic bedrock Fill: 85% for fill of keyed in angular rock		
21+400 454460 6201333 **Sec. 2-MM**	**21+475** 454492 6201343	30-40% at the switchback location 70-80% upslope of the switchback	The alignment turns a switchback on a small (approximately 25m wide) moderate gradient bench which is bounded by a steep gradient slope above. No other switchback locations were noted to the south of the alignment as terrain continues to steepen in this direction. Construction of the switchback on this small of a bench feature will require a large fill along the lower leg of the switchback and a large cut along the upper leg. Significant endhaul volumes are expected to result from construction at this location. Road construction at the site is expected to result in a large bedrock cutslope along the upper leg of the switchback. Surficial materials consist of a thin blanket of well drained silty sand with some gravel colluvium		1-2m	Well	**High:** Mid-sized (<1000m^3) fill slope failure due to placement of a large fill on moderate to moderately steep gradient terrain along the lower leg of the switchback. Runout is expected to terminate on benched terrain approximately 80m downslope.	Sediment delivery to Bitter Creek. **Low**	**Moderate**	• **¼ to ½ bench cut construction along the lower leg of the switchback transitioning into Full Bench Cut construction along the upper leg.** • Construction the fill slope of the road along the lower leg of the switchback out of keyed in angular rock founded on natural or excavated bench. • A minimum of 0.8m diameter clast size should be used for the base layer of the keyed in rock fill to ensure that the fill is well founded. • If deeper then are expected surficial materials are encountered along the upper leg of the switchback, the resulting cutslope must be buttressed with keyed in angular rock to prevent sloughing and retrogression. • Scale the rock cut along the road section during and following the completion of construction activities. Cut: 100% in well drained colluvium deposits 200% in metavolcanic bedrock Fill: 85% for fill of keyed in angular rock	**Low**	**V. Low**
							Moderate: Small scale cutslope sloughing and retrogression if deeper than expected surficial materials are encountered. Runout is expected to terminate on the proposed road alignment.	Hazard to road users or road construction workers. **Moderate**	**Moderate**		**Low**	**Low**
								Chronic maintenance concern with frequent blockage of the road alignment. **Moderate**	**Moderate**			**Low**
							Moderate: Small scale (<1m^3) rock detachment from the large bedrock cut along this road section. Runout is expected to terminate on the proposed road.	Hazard to road users or road construction workers. **Moderate**	**Moderate**		**Low**	**Low**
21+475 454492 6201343 **Sec. 2-NN**	**21+620** 454457 6201484	70-85%	Terrain is planar to somewhat irregular with steep slope gradients. Much of the timber observed on the slope show signs of sweep and pistol butte forms. This may be the result of a large snowpack and snow creep but there is likely also some degree of soil creep at the site. The steep slope gradients coupled with what appear to be shallow soils suggest that soil creep is also likely.		0-1m	Well	**High:** Mid-sized (<1000m^3) fill slope failure due to placement of a large fill on moderate to moderately steep gradient terrain along the lower leg of the switchback. Runout is expected to terminate on benched terrain approximately 80m	Sediment delivery to Bitter Creek. **Low**	**Moderate**	• **Full Bench Cut construction.** • Endhaul all excess material to a suitable waste site. Suitable waste sites are present at the centre of the switchback at 21+080 and from 20+290 to 20+420 downslope of the proposed alignment. Cut: 100% in well drained colluvium deposits 200% in metavolcanic bedrock	**Low**	**V. Low**

Table 6.2: Red Mountain Gold Mine Access Route Section 2 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
			Bedrock is visible outcropping in isolated locations and consists of medium strong to very strong metavolcanic rock. Road construction at the site is expected to result in a large bedrock cutslope. Surficial materials consist of a veneer to thin blanket of well drained silty sand with some gravel colluvium.				downslope.			Fill: 85% for fill of keyed in angular rock		
							Moderate: Small scale (<1m^3) rock detachment from the large bedrock cut along this road section. Runout is expected to terminate on the proposed road.	Hazard to road users or road construction workers. **Moderate**	**Moderate**		**Low**	**Low**
21+620 454457 6201484 **Sec. 2-OO**	**21+740** 454443 6201598	30-50%	Terrain is planar to benched with moderate slope gradients. Surficial materials consist of a veneer to thin blanket of well drained silty sand with some gravel colluvium.		1-2m	Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on benched terrain immediately downslope of the proposed road location.	**N/A**	**N/A**	• Cut and fill construction. Cut: 100% in well drained colluvium deposits Fill: 70% for fill of sidecast local material. 85% for fill of keyed in angular rock	**Low**	**N/A**
21+740 454443 6201598 **Sec. 2-PP**	**21+850** 454486 6201584	20-30% at the road location 60-70% upslope of the road	The alignment turns a switchback on a broad bench feature with steep bedrock controlled terrain above. Slope break over to the north of the switchback and steep bedrock controlled terrain is also present. Surficial materials consist of a veneer to thin blanket of well drained silty sand with some gravel colluvium.		1-2m	Well	**Moderate:** Mid-sized (<1000m^3) fill slope failure due to fill placement extending off of the bench onto steep gradient terrain to the north of the switchback. Runout is expected to terminate 300-400m downslope when slope gradients begin to slacken.	Sediment delivery to Bitter Creek. **Low**	**Low**	• Cut and fill construction. • Ensure that the fill slope of the switchback does not extend onto the steep gradient terrain to the north. Cut: 100% in well drained colluvium deposits Fill: 70% for fill of sidecast local material. 85% for fill of keyed in angular rock	**Low**	**V. Low**
21+850 454486 6201584 **Sec. 2-QQ**	**22+005** 454559 6201450	70-80% above the road 55-65% below the road	The alignment tracks the toe of steep gradient terrain with extensive bedrock outcrops. Slopes below the alignment are planar to benched with moderately steep slope gradients. Bedrock is visible outcropping in numerous locations and consists of medium strong to very strong whitish metavolcanic bedrock. Road construction at the site is expected to result in a large bedrock cutslope. Surficial materials consist of a veneer of rubble colluvium in a silty sand matrix.		0-1m	Well	**Moderate:** Mid-sized (<1000m^3) fill slope failure due to fill placement on moderately steep gradient terrain. Runout is expected to terminate on gentle to moderate gradient benched terrain approximately 150-200m downslope.	Sediment delivery to Bitter Creek. **Low**	**Low**	• **Full bench cut construction.** • Shift to ¾ bench cut construction with fill composed of keyed in angular rock where sufficient surface irregularity allows for fill placement. • Endhaul all excess material to a suitable waste site. Suitable waste sites are present in the centre of the preceding switchback and from 20+290 to 20+420 downslope of the proposed alignment. • Scale the rock cut along the road section during and following the completion of construction activities. Cut: 100% in well drained colluvium deposits 200% in metavolcanic bedrock Fill: 85% for fill of keyed in angular rock	**Low**	**V. Low**
							Moderate: Small scale (<1m^3) rock detachment from the large bedrock cut along this road section. Runout is expected to terminate on the proposed road.	Hazard to road users or road construction workers. **Moderate**	**Moderate**		**Low**	**Low**
22+005 454559 6201450 **Sec. 2-RR**	**22+035** 454580 6201427	50-55% at the road location 70-80% upslope of the road	The alignment crosses of mouth of a large bedrock controlled gully feature. Upslope of the road location the gully is deeply incised but fades out at and downslope of the road location. The gully is choked with angular talus mainly ranging from 0.3-0.5m in diameter although some isolated clasts up to 1m in diameter are present. No signs of surface flows are present in the gully and the feature does not		1-2m	Rapid	**Moderate:** Natural rockfall and colluvium sloughing events in the gully upslope of the road location. Propagation of single rock clasts to the road location.	Hazard to road users or road construction workers. **Moderate**	**Moderate**	• **¾ Bench Cut construction with fill composed of keyed in angular rock founded on a natural or excavated bench.** • Rock can be sourced by reworking the angular talus deposits present at the site. • Endhaul all excess material to a suitable waste site. Suitable waste sites are present in the centre of the	**Mod**	**Low**
								Chronic maintenance concern with	**Moderate**			**Mod**

Table 6.2: Red Mountain Gold Mine Access Route Section 2 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
			appear to be linked to fluvial processes. It is more likely that the gully represents a fault or weak zone in the local bedrock mass which has weathered differentially with respect to the surrounding rock. Rockfall and rolling rock events appear to be frequent in the gully and represent the dominant geomorphic process. However, the road is situated at the distal end of the rockfall and rolling rock runout zone and it appears that the majority of these events terminate prior to the road location. Surficial materials consist of a veneer to thin blanket of angular talus overlying bedrock.					frequent blockage of the road alignment. **Moderate**		preceding switchback and from 20+290 to 20+420 downslope of the proposed alignment. • Install rockfall hazard signage and implement a no stopping zone.		
							Moderate: Small (<500m^3) cutslope failure or sloughing event due to large road cut in unconsolidated angular talus deposits. Runout is expected to terminate on the proposed road.	Hazard to road users or road construction workers. **Moderate**	**Moderate**	Cut: 100% in angular talus deposits 200% in metavolcanic bedrock Fill: 85% for fill of keyed in angular rock	**Low**	**Low**
								Chronic maintenance concern with frequent blockage of the road alignment. **Moderate**	**Moderate**			**Low**
22+035 454580 6201427 **Sec. 2-SS**	**22+120** 454616 6201354	60-70%	Terrain is planar to somewhat irregular with moderately steep slope gradients. Surficial materials consist of a veneer of rubble colluvium in a silty sand matrix.		0-1m	Well	**Moderate:** Mid-sized (<1000m^3) fill slope failure due to fill placement on moderately steep gradient terrain. Runout is expected to terminate on gentle to moderate gradient benched terrain approximately 150-200m downslope.	Sediment delivery to Bitter Creek. **Low**	**Low**	• **Full bench cut construction.** • Shift to ¾ bench cut construction with fill composed of keyed in angular rock where sufficient surface irregularity allows for fill placement. • Endhaul all excess material to a suitable waste site. Suitable waste sites are present in the centre of the preceding switchback and from 20+290 to 20+420 downslope of the proposed alignment. Cut: 100% in well drained colluvium deposits 200% in metavolcanic bedrock Fill: 85% for fill of keyed in angular rock	**Low**	**V. Low**
22+120 454616 6201354 **Sec. 2-TT**	**22+230** 454691 6201276	20-40% at the road location 70-80% downslope	The alignment climbs up to and traverses the crest of a sharp slope break. Steep gradient terrain is present below the alignment while irregular moderate gradient terrain is present above the alignment. The slope break appears to be bedrock controlled. Surficial materials consist of a veneer of rubble colluvium in a silty sand matrix.		0-1m	Well	**Moderate:** Mid-sized (<1000m^3) fill slope failure due to fill placement on steep gradient terrain. Runout is expected to terminate at the base of the Goldslide Creek draw approximately 200m downslope. A portion of the slide material may be entrained in Goldslide Creek and transported downstream to Bitter Creek.	Sediment delivery to Goldslide Creek. **High**	**High**	• **Full bench cut construction.** • Shift to ¾ bench cut construction with fill composed of keyed in angular rock where sufficient surface irregularity allows for fill placement. • Endhaul all excess material to a suitable waste site. Suitable waste sites are present in the centre of the preceding switchback and from 20+290 to 20+420 downslope of the proposed alignment. Cut: 100% in well drained colluvium deposits 200% in metavolcanic bedrock Fill: 85% for fill of keyed in angular rock	**Low**	**Mod.**
								Sediment delivery to Bitter Creek. **Moderate**	**Moderate**			**Low**
22+230 454691 6201276 **Sec. 2-UU**	**22+565** 454720 6201406	20-40%	The alignment pulls away from the crest of the steep slope and turns a series of switchbacks through a series of gentle to moderate gradient benches and small ridge features. The benches and small ridge features are interpreted as a series of terminal moraines associated with a past glacier		1-2m	Mod. Well to Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on benched terrain immediately downslope of the proposed road location.	**N/A**	**N/A**	• Cut and fill construction. • Install a 600mm diameter cross drain culvert at 22+300 to address minor surface flow. Cut: 100% in moderately well to well drained morainal deposits Fill: 70% for fill of sidecast local material.	**Low**	**N/A**

Table 6.2: Red Mountain Gold Mine Access Route Section 2 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
			which flowed out of the alpine bowl area upslope. A low point with small amounts of standing water was crossed at 22+230. No signs of stream channel were noted in this location. The Goldslide Creek draw is situated 40-80m to the southeast of the road location. The sidewall of the creek draw is composed of weathered rock and is not expected to retrogress to the proposed road location. Surficial materials consist of moderately well to well drained silty sand with some gravel morainal deposits.									
22+565 454720 6201406 **Sec. 2-VV**	**22+680** 454723 6201454	20-50%	The alignment climbs up to gain a large gentle to moderate gradient bench feature to turn a switchback. A large bedrock controlled gully feature is situated immediately to the northwest of the switchback. A series of small bedrock bluffs are present directly upslope of the upper leg of the switchback. The bluffs appear to host frequent small scale rockfall events as indicated by the lobes of angular talus which have accumulated on the bench where the switchback is situated. Surficial materials consist of a veneer to thin blanket of angular talus overlying silty sand with some gravel morainal deposits. These materials thin along the upper leg of the switchback where a thin veneer of rubble overlies bedrock.		0-2m	Well	**Moderate**: Small scale (<1m^3) rock detachment from the bedrock bluffs upslope of the upper leg of the switchback. Runout is expected to terminate on the proposed road alignment.	Hazard to road users or road construction workers. **Moderate**	**Moderate**	• Cut and fill construction. • Scale the bedrock bluffs upslope of the upper leg of the switchback during and following the completion of construction activities. Cut: 100% in well drained colluvium deposits 200% in metavolcanic bedrock Fill: 70% for fill of sidecast local material 85% for fill of keyed in angular rock	**Low**	**Low**
22+680 454723 6201454 **Sec. 2-WW**	**22+715** 454751 6201434	70-90% at the road location 30-50% above and below the road	The alignment climbs up through a series of small bluffs to gain an overlying moderate gradient bench feature. Surficial materials consist of a thin veneer of rubble colluvium overlying bedrock.		0-0.5m	Well	**Moderate**: Small scale (<1m^3) rock detachment from the bedrock bluffs at the road location or the resulting road cut. Runout is expected to terminate on the proposed road alignment.	Hazard to road users or road construction workers. **Moderate**	**Moderate**	• Cut and fill construction at the start of the section transitioning into Full Bench Cut when climbing up through the bluffs. • Scale the bedrock bluffs at the road location and the resulting road cut during and following the completion of construction activities. Cut: 100% in well drained colluvium deposits 200% in metavolcanic bedrock Fill: 70% for fill of sidecast local material 85% for fill of keyed in angular rock	**Low**	**Low**
22+715 454751 6201434 **Sec. 2-XX**	**22+830** 454825 6201351	30-50% at and downslope of the road 60-70% upslope of the road	Terrain is irregular and benched with moderate to moderately steep slope gradients. Surficial materials consist of a veneer of rubble colluvium overlying bedrock.		0-1m	Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on benched terrain immediately downslope of the proposed road location.	**N/A**	**N/A**	• Cut and fill construction with sections of full bench cut where required due to vertical alignment. Cut: 100% in well drained colluvium deposits 200% in metavolcanic bedrock Fill: 70% for fill of sidecast local material 85% for fill of keyed in angular rock	**Low**	**N/A**
22+830 454825	**22+880** 454863	60-70%	The alignment climbs up a short moderately steep gradient escarpment. The escarpment is bedrock controlled and the surrounding terrain is irregular and		0-1m	Well	**Moderate:** Small (<500m^3) fill slope failure due to fill placement on moderately	Sediment delivery to Goldslide Creek.	**Low**	• **Full bench cut construction.** • Shift to ¾ bench cut construction with fill composed	**Low**	**V. Low**

Table 6.2: Red Mountain Gold Mine Access Route Section 2 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
6201351 **Sec. 2-YY**	6201321		benched. Surficial materials consist of a veneer of rubble colluvium overlying bedrock.				steep gradient terrain. Runout is expected to terminate on gentle to moderate gradient benched terrain within 40m downslope.	**Low** Sediment delivery to Bitter Creek. **Low**	 **Low**	of keyed in angular rock where sufficient surface irregularity allows for fill placement. • Endhaul all excess material to a suitable waste site. Suitable waste sites are present on the bench where the preceding switchback is located (22+640). Cut: 100% in well drained colluvium deposits 200% in metavolcanic bedrock Fill: 85% for fill of keyed in angular rock		 **V. Low**
22+880 454863 6201321 **Sec. 2-ZZ**	**23+025** 454869 6201406	20-40%	The alignment turns a switchback on a broad bench adjacent to Goldslide Creek and the climbs to the north tracking a moderate gradient bench. Surficial materials consist of a veneer of rubble colluvium overlying bedrock.		0-1m	Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on benched terrain immediately downslope of the proposed road location.	**N/A**	**N/A**	• Cut and fill construction. Cut: 100% in well drained colluvium deposits 200% in metavolcanic bedrock Fill: 70% for fill of sidecast local material 85% for fill of keyed in angular rock	**Low**	**N/A**
23+025 454869 6201406 **Sec. 2-AAA**	**23+070** 454841 6201441	50-55%	The alignment climbs up a short bedrock controlled escarpment with moderately steep slope gradients. Terrain benches 20-30m downslope of the road location. Surficial materials consist of a veneer of rubble colluvium overlying bedrock.		0-1m	Well	**Moderate:** Small (<500m^3) fill slope failure due to fill placement on moderately steep gradient terrain. Runout is expected to terminate on gentle to moderate gradient benched terrain within 40m downslope.	Sediment delivery to Goldslide Creek. **Low** Sediment delivery to Bitter Creek. **Low**	**Low** **Low**	• **½ Bench Cut construction with fill composed of keyed in angular rock founded on a natural or excavated bench.** Cut: 100% in well drained colluvium deposits 200% in metavolcanic bedrock Fill: 85% for fill of keyed in angular rock	**Low**	**V. Low** **V. Low**
23+070 454841 6201441 **Sec. 2-BBB**	**23+135** 454878 6201448	25-35% at the switchback location 65-75% upslope of the switchback	The alignment turns a switchback on a small moderate gradient bench feature. The bench is bedrock controlled with rock outcrops at surface. Surficial materials consist of a veneer of rubble colluvium overlying bedrock.		0-0.5m	Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on benched terrain immediately downslope of the proposed road location.	**N/A**	**N/A**	• Cut and fill construction. Cut: 100% in well drained colluvium deposits 200% in metavolcanic bedrock Fill: 70% for fill of sidecast local material 85% for fill of keyed in angular rock	**Low**	**N/A**
23+135 454878 6201448 **Sec. 2-CCC**	**23+220** 454936 6201390	40-50% at the road location 70-80% upslope of the road location	The alignment tracks a small moderate gradient bench with steep gradient terrain upslope. Surficial materials consist of a veneer of rubble colluvium overlying bedrock.		0-1m	Well	**Moderate:** Small (<500m^3) fill slope failure due to fill placement extending off of the bench feature onto moderately steep gradient terrain. Runout is expected to terminate on gentle to moderate gradient benched terrain within 60m downslope.	Sediment delivery to Goldslide Creek. **Low** Sediment delivery to Bitter Creek. **Low**	**Low** **Low**	• ¾ Bench Cut construction with fill composed of native sidecast material. • Endhaul all excess material to a suitable waste site. Suitable waste sites are present on the bench where the preceding switchback is located (23+090). Cut: 100% in well drained colluvium deposits 200% in metavolcanic bedrock Fill: 70% for fill of sidecast local material	**Low**	**N/A**
23+220 454936 6201390 **Sec. 2-DDD**	**23+270** 454978 6201360	55-70%	Terrain is irregular and slightly benched with moderately steep slope gradients. Surficial materials consist of a veneer of rubble colluvium overlying bedrock.		0-1m	Well	**Moderate:** Small (<500m^3) fill slope failure due to fill placement extending off of the bench feature onto moderately steep gradient terrain. Runout is expected to	Sediment delivery to Goldslide Creek. **Low** Sediment delivery to Bitter Creek.	**Low** **Low**	• **¾ Bench Cut construction with fill composed of keyed in angular rock founded on a natural or excavated bench.** • Endhaul all excess material to a suitable waste site. Suitable waste sites are present on the bench where the preceding switchback is located (23+090).	**Low**	**V. Low** **V. Low**

Table 6.2: Red Mountain Gold Mine Access Route Section 2 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
							terminate on gentle to moderate gradient benched terrain within 60m downslope.	**Low**		Cut: 100% in well drained colluvium deposits 200% in metavolcanic bedrock Fill: 85% for fill of keyed in angular rock		
23+270 454978 6201360 **Sec. 2-EEE**	**23+350** 455005 6201382	20-40% at the switchback >100% to the southeast	The alignment turns a switchback on a broad gentle to moderate gradient bench. The incised Goldslide Creek draw is situated immediately to the southeast of the switchback location. The sidewall of the Goldslide Creek draw adjacent to the proposed switchback is approximately 30m long and has sidewall slopes in excess of 100%. The sidewall slope consists of weathered bedrock overlain by a veneer of rubble colluvium. The sidewall slope is actively raveling through small scale rockfall and rock detachment events. The top of the sidewall slope does not show sign of major retrogression such as slumping or tension cracking; however, small scale retrogression should be expected over the long term due to the relatively weak nature of the rock at the site. Surficial materials consist of a veneer to thin planar of rubble colluvium in a silty sand matrix.		1m	Well	**Moderate:** Long term retrogression of the sidewall slope of Goldslide Creek leading to eventual impact to the proposed road alignment. Failure of the road prism and sediment introduction into Goldslide Creek.	Sediment delivery to Goldslide Creek. **High**	**High**	• Cut and fill construction. • **Ensure the outer edge of the road prism is situated a minimum of 10m back from the crest of the Goldslide Creek draw.** Cut: 100% in well drained colluvium deposits 200% in metavolcanic bedrock Fill: 70% for sidecast local material 85% for fill of keyed in angular rock	**Low**	**Mod.**
								Sediment delivery to Bitter Creek. **Moderate**	**Moderate**			**Low**
								Loss of access on the proposed road alignment. Reconstruction may involve a significant reroute of the alignment. **Moderate**	**Moderate**			**Low**
23+350 455005 6201382 **Sec. 2-FFF**	**23+500** 454928 6201508	55-65%	The alignment climbs out of the switchback through moderately steep planar to somewhat irregular terrain. Surficial materials consist of a veneer to thin planar of rubble colluvium in a silty sand matrix.		1m	Well	**Moderate:** Small (<500m^3) fill slope failure due to fill placement onto moderately steep gradient terrain. Runout is expected to terminate on gentle to moderate gradient benched terrain within 60m downslope.	Sediment delivery to Goldslide Creek. **Low**	**Low**	• **¾ Bench Cut construction with fill composed of keyed in angular rock founded on a natural or excavated bench.** • Shift to Full Bench Cut construction if sufficient rock or surface irregularity is not present to construct a keyed in rock fill. • Endhaul all excess material to a suitable waste site. Suitable waste sites are present on the bench where the preceding switchback is located (23+090). Cut: 100% in well drained colluvium deposits 200% in metavolcanic bedrock Fill: 85% for fill of keyed in angular rock	**Low**	**V. Low**
								Sediment delivery to Bitter Creek. **Low**	**Low**			**V. Low**
23+500 454928 6201508 **Sec. 2-GGG**	**23+575** 454883 6201565	40-50%	Terrain is planar to somewhat irregular with moderate gradient terrain. Slopes break over to 60% approximately 10-20m downslope of the road location. Surficial materials consist of a veneer to thin planar of rubble colluvium in a silty sand matrix.		1m	Well	**Moderate:** Small (<500m^3) fill slope failure due to fill placement onto moderately steep gradient terrain. Runout is expected to terminate on gentle to moderate gradient benched terrain within 60m downslope.	Sediment delivery to Goldslide Creek. **Low**	**Low**	• Cut and fill construction. • Shift to ¾ bench cut construction where required to ensure that the fill slope of the road does not propagate onto the moderately steep gradient terrain downslope of the alignment. Cut: 100% in well drained colluvium deposits 200% in metavolcanic bedrock Fill: 70% for sidecast local material 85% for fill of keyed in angular rock	**Low**	**V. Low**
								Sediment delivery to Bitter Creek. **Low**	**Low**			**V. Low**
23+575 454883	**23+645** 454918	20-40% at the switchback	The alignment turns a switchback around a small moderate gradient bench feature. Slopes roll off into moderately steep gradient terrain downslope of the		0-0.5m	Well	**Moderate:** Small (<500m^3) fill slope failure due to fill placement onto moderately	Sediment delivery to Goldslide Creek.	**Low**	• ½ bench cut construction along the lower leg of the switchback shifting into Full Bench Cut construction	**Low**	**V. Low**

Table 6.2: Red Mountain Gold Mine Access Route Section 2 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
6201565 **Sec. 2-HHH**	6201581	location 50-60% downslope of the switchback 65-75% upslope of the switchback	switchback. Moderately steep to steep gradient terrain is present upslope of the switchback. The relatively small size of the bench that the switchback is situated on requires fill placement extending onto the moderately steep gradient terrain downslope of the bench. Similarly, the upper leg of the switchback extends onto the moderately steep to steep gradient terrain upslope of the bench. This will result in a large rock cut along the upper leg of the switchback. Surficial materials consist of a thin veneer of angular talus overlying bedrock.				steep gradient terrain downslope of the lower leg of the switchback. Runout is expected to terminate on gentle to moderate gradient benched terrain within 100m downslope.	**Low**		along the upper leg of the switchback. • Construct the fill along the lower leg of the switchback out of keyed in angular rock. • Ensure the base of the rock fill is well founded on a bench ripped into the local bedrock at the site. • Large rock clasts (>0.8m diameter) should be used as the base layer for the keyed in rock fill. • Scale the rock cut along the road section during and following the completion of construction activities. Cut: 100% in well drained colluvium deposits 200% in metavolcanic bedrock Fill: 85% for fill of keyed in angular rock		
								Sediment delivery to Bitter Creek. **Low**	**Low**			**V. Low**
							Moderate: Small scale (<1m^3) rock detachment from the large road cut along the upper leg of the switchback. Runout is expected to terminate on the proposed road alignment.	Hazard to road users or road construction workers. **Moderate**	**Moderate**		**Low**	**Low**
23+645 454918 6201581 **Sec. 2-III**	**23+705** 454971 6201553	30-50%	Terrain is planar to somewhat irregular with moderate slope gradients. Surficial materials consist of a veneer to thin planar of rubble colluvium in a silty sand matrix.		0-1m	Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on benched terrain immediately downslope of the proposed road location.	**N/A**	**N/A**	• Cut and fill construction is feasible at the site; however, the road remains in full bench cut due to vertical alignment constraints. Cut: 100% in well drained colluvium deposits 200% in metavolcanic bedrock Fill: 70% for fill of sidecast local material 85% for fill of keyed in angular rock	**Low**	**N/A**
23+705 454971 6201553 **Sec. 2-JJJ**	**23+755** 455004 6201517	60-70%	The alignment climbs up through a series of small bedrock bluffs to gain the apex of a bedrock promontory. Irregular slopes with moderately steep gradients are present. Road construction through this area is expected to result in a large rock cut. Surficial materials consist of a thin veneer of rubble colluvium over bedrock.		0m	Well	**Moderate:** Mid-sized (<1000m^3) fill slope failure due to fill placement onto moderately steep gradient terrain. Runout is expected to terminate on gentle to moderate gradient benched terrain within 100-150m downslope.	Sediment delivery to Goldslide Creek. **Low**	**Low**	• **Full Bench Cut construction.** • Endhaul all excess material to a suitable waste site. Suitable waste sites are present in the centres of the preceding switchbacks at 23+310 and 23+600. • Scale the rock cut along the road section during and following the completion of construction activities. Cut: 200% in metavolcanic bedrock Fill: N/A – Endhaul all excess material	**Low**	**V. Low**
								Sediment delivery to Bitter Creek. **Low**	**Low**			**V. Low**
							Moderate: Small scale (<1m^3) rock detachment from the large road cut along the upper leg of the switchback. Runout is expected to terminate on the proposed road alignment.	Hazard to road users or road construction workers. **Moderate**	**Moderate**		**Low**	**Low**
23+755 455004 6201517 **Sec. 2-KKK**	**23+875** 455055 6201591	10-25%	The alignment climbs up a broad bedrock controlled ridge via two stacked switchbacks. Irregular terrain with gentle slope gradients is present at the site. Surficial materials consist of a thin veneer of angular talus over bedrock.		0.5m	Well	**Very Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on gentle gradient terrain immediately downslope of the alignment.	**N/A**	**N/A**	• Cut and fill construction. Cut: 200% in metavolcanic bedrock Fill: 70% for fill of sidecast local material	**V. Low**	**N/A**
23+875 455055 6201591	**23+930** 455104 6201573	10-25% at the road location Short pitch of	The alignment tracks gentle gradient bench at the toe of a series of small bedrock outcrops and bluffs. The bedrock outcrops are heavily weathered and covered in a veneer of loose angular talus. The bench where the		1-2m	Well	**Moderate**: Small scale (<1m^3) rock detachment from the bedrock outcrops upslope of the road. Runout is expected	Hazard to road users or road construction workers.	**Moderate**	• Cut and fill construction. • Install a 2m wide rockfall catchment ditch along the inner edge of the alignment.	**Low**	**Low**

Table 6.2: Red Mountain Gold Mine Access Route Section 2 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
Sec. 2-LLL		>100% above	alignment is situated is also covered by a layer of angular talus. This suggests that small scale rock detachments consisting of single rolling rocks are relatively frequent. The heavily fractured nature of the bedrock outcrops means that scaling may not be effective. A small rockfall catchment ditch at the site may be more effective. Surficial materials consist of a thin blanket of angular talus overlying bedrock.				to terminate on the proposed road alignment.	**Moderate**		Cut: 100% in well drained colluvium deposits 200% in metavolcanic bedrock Fill: 70% for fill of sidecast local material		
23+930 455104 6201573 **Sec. 2-MMM**	**24+090** 455237 6201653	40-50%	The alignment swings around a ridge and traverses planar to somewhat irregular moderate gradient terrain directly upslope of the Goldslide Creek draw. The sidewall of the Goldslide Creek draw downslope of the road section is approximately 100m long and has sidewall slopes in excess of 100%. The sidewall slope consists of weathered bedrock overlain by a veneer of rubble colluvium. The sidewall slope is actively raveling through small scale rockfall and rock detachment events. The top of the sidewall slope does not show sign of major retrogression such as slumping or tension cracking; however, small scale retrogression should be expected over the long term due to the weak nature of the rock at the site. The bedrock outcrops upslope of the preceding road section fade out and rockfall events are no longer expected to impact the road. Surficial materials consist of a thin blanket of angular talus overlying bedrock.		1m	Well	**Moderate:** Long term retrogression of the sidewall slope of Goldslide Creek leading to eventual impact to the proposed road alignment. Failure of the road prism and sediment introduction into Goldslide Creek.	Sediment delivery to Goldslide Creek. **High**	**High**	• Cut and fill construction. • **Ensure the outer edge of the road prism is situated a minimum of 10m back from the crest of the Goldslide Creek draw.** Cut: 100% in well drained colluvium deposits 200% in metavolcanic bedrock Fill: 70% for sidecast local material 85% for fill of keyed in angular rock	**Low**	**Mod.**
								Sediment delivery to Bitter Creek. **Moderate**	**Moderate**			**Low**
								Loss of access on the proposed road alignment. Reconstruction may involve a significant reroute of the alignment. **Moderate**	**Moderate**			**Low**
24+090 455237 6201653 **Sec. 2-NNN**	**24+440** 455486 6201869	20-40%	The alignment ties into and tracks an existing road alignment. The existing alignment appears to have been constructed using cat push or cut and fill methods out of local colluvium deposits. No signs of instability were noted in the existing road prism. Terrain is planar to somewhat irregular with gentle to moderate slope gradients. Cross a small stream at 24+315. The stream emerges from the subsurface in a small bowl approximately 50m upslope of the road location. Precipitate is present at the emergence point of the stream. The precipitate did not react to acid and as a result is not calcareous in composition. The road is now situated in a large alpine bowl. The area is likely subjected to snow avalanche activity during the winter months. Surficial materials consist of a blanket of gravelly sand with some silt till or morainal deposits overlain by a thin veneer of angular rubble colluvium.		2m	Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on gentle to moderate gradient terrain immediately downslope of the alignment.	**N/A**	**N/A**	• Upgrade the existing alignment through conventional cut and fill methods. • Install a 600mm diameter culvert at 24+315 to address stream flow. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: 100% in well drained morainal deposits 200% in metavolcanic bedrock Fill: 70% for fill of sidecast local material	**Low**	**N/A**
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**		**Low**	**Low**

Table 6.2: Red Mountain Gold Mine Access Route Section 2 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
24+440 455486 6201869 **Sec. 2-OOO**	**24+730** 455765 6201938	35-50%	The alignment climbs above the existing road to reduce the road grade. A bedrock outcrop is present at surface near the start of the road section. Deeper surficial material deposits surround the outcrop. Surficial materials consist of a blanket of gravelly sand with some silt till or morainal deposits overlain by a thin veneer of angular rubble colluvium.		0-3m	Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on gentle to moderate gradient terrain immediately downslope of the alignment.	**N/A**	**N/A**	• Cut and fill construction with a large sidecast fill extending down to the existing road prism. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: 100% in well drained morainal deposits 200% in metavolcanic bedrock Fill: 70% for fill of sidecast local material	**Low**	**N/A**
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**		**Low**	**Low**
24+730 455765 6201938 **Sec. 2-PPP**	**24+885** 455920 6201961	10-30%	The alignment ties back into and follows the existing road. Terrain is planar to benched with gentle to moderate slope gradients. Surficial materials consist of a blanket of gravelly sand with some silt till or morainal deposits overlain by a thin veneer of angular rubble colluvium.		3m	Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on gentle to moderate gradient terrain immediately downslope of the alignment.	**N/A**	**N/A**	• Upgrade the existing alignment through conventional cut and fill methods. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: 100% in well drained morainal deposits 200% in metavolcanic bedrock Fill: 70% for fill of sidecast local material	**Low**	**N/A**
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**		**Low**	**Low**
24+885 455920 6201961 **Sec. 2-QQQ**	**25+175** 455988 6202058	30-40%	The alignment leaves the existing road and climbs up through a moderate gradient slope via a double switchback. Surficial materials consist of a blanket of gravelly sand with some silt till or morainal deposits overlain by a thin veneer of angular rubble colluvium.		3m	Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on gentle to moderate gradient terrain immediately downslope of the alignment.	**N/A**	**N/A**	• Cut and fill construction. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: 100% in well drained morainal deposits 200% in metavolcanic bedrock Fill: 70% for fill of sidecast local material	**Low**	**N/A**
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**		**Low**	**Low**
25+175 455988 6202058 **Sec. 2-RRR**	**25+260** 456055 6202107	40-50%	Terrain is planar to somewhat irregular with moderate slope gradients. Bedrock is visible outcropping on the existing alignment upslope of the proposed road and as a result bedrock may be encountered during construction. Surficial materials consist of a blanket of gravelly sand with some silt till or morainal deposits overlain by a thin veneer of angular rubble colluvium.		1m	Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on gentle to moderate gradient terrain immediately downslope of the alignment.	**N/A**	**N/A**	• Cut and fill construction. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: 100% in well drained morainal deposits 200% in metavolcanic bedrock Fill: 70% for fill of sidecast local material	**Low**	**N/A**
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction	**High**		**Low**	**Low**

Table 6.2: Red Mountain Gold Mine Access Route Section 2 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
								workers. **Moderate**				
25+260 456055 6202107 **Sec. 2-SSS**	**25+310** 456097 6202133	30-40%	The alignment crosses over a small stream draw and ties into the existing road. Terrain is irregular with moderate slope gradients. The stream is crossed at 25+285. The base of the draw and the stream channel is choked with gravel to cobbled sized angular material and appears to transport significant sediment volumes during high flow events. The channel is approximately 1m wide. Due to the high sediment loads present, the drainage structure on the stream will need to be oversized to allow for sediment infilled and to pass a portion of the sediment. Surficial materials consist of a blanket of gravelly sand with some silt till or morainal deposits overlain by a thin veneer of angular rubble colluvium.		2-3m	Well	**Moderate:** Culvert infilling due to high sediment loads on the stream. Washout of the road prism and entrainment of a portion of the material with transport to Goldslide Creek.	Sediment delivery to Goldslide Creek. **Moderate**	**Moderate**	• Cut and fill construction. • Install an 800mm diameter culvert at 25+285 to address stream flow and sediment movement. • Excavate a large sump at the culvert inlet and clean the sump seasonally. • Armour the culvert inlet and outlet with angular rock. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: 100% in well drained morainal deposits 200% in metavolcanic bedrock Fill: 70% for fill of sidecast local material	**Low**	**Low**
								Sediment delivery to Bitter Creek. **Low**	**Low**			**V. Low**
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**		**Low**	**Low**
25+310 456097 6202133 **Sec. 2-TTT**	**25+405** 456186 6202156	15-30%	**This portion of the alignment was not reviewed on foot in the field. The risk assessment and construction recommendations are based on office interpretation of the Lidar terrain model and orthoimagery of the site.** The alignment tracks the existing road. Terrain is planar to benched with gentle to moderate slope gradients. Surficial materials consist of a blanket of gravelly sand with some silt till or morainal deposits overlain by a thin veneer of angular rubble colluvium.		2-3m	Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on gentle to moderate gradient terrain immediately downslope of the alignment.	**N/A**	**N/A**	• Upgrade the existing alignment through conventional cut and fill methods. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: 100% in well drained morainal deposits 200% in metavolcanic bedrock Fill: 70% for fill of sidecast local material	**Low**	**N/A**
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**		**Low**	**Low**
25+405 456186 6202156 **Sec. 2-UUU**	**25+715** 456224 6202292	20-40%	**This portion of the alignment was not reviewed on foot in the field. The risk assessment and construction recommendations are based on office interpretation of the Lidar terrain model and orthoimagery of the site.** The alignment leaves the existing road. Terrain is irregular and somewhat benched with moderate slope gradients. The alignment crosses over an incised stream draw at 25+420 and again at 25+580. The stream at the base of the draw has a channel that is 1-2m wide and appears to carry substantial flow during the spring freshet period. The stream draw is choked with gravel to cobble sized angular material and appears to transport significant sediment volumes during high flow events. Surficial materials consist of a blanket of gravelly sand with some silt till or morainal deposits overlain by a thin veneer of angular rubble colluvium.		2-3m	Well	**Moderate:** Culvert infilling due to high sediment loads on the stream. Washout of the road prism and entrainment of a portion of the material with transport to Goldslide Creek.	Sediment delivery to Goldslide Creek. **Moderate**	**Moderate**	• Cut and fill construction. • Install 1000mm diameter culverts at 25+420 and 25+580 to address stream flow and sediment movement. • Excavate a large sump at each of the culvert inlets and clean the sumps seasonally. • Armour the culvert inlets and outlets with angular rock. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: 100% in well drained morainal deposits 200% in metavolcanic bedrock Fill: 70% for fill of sidecast local material	**Low**	**Low**
								Sediment delivery to Bitter Creek. **Low**	**Low**			**V. Low**
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**		**Low**	**Low**

Table 6.2: Red Mountain Gold Mine Access Route Section 2 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
25+715 456224 6202292 **Sec. 2-VVV**	**25+835** 456337 6202321	40-50%	**This portion of the alignment was not reviewed on foot in the field. The risk assessment and construction recommendations are based on office interpretation of the Lidar terrain model and orthoimagery of the site.** Terrain is irregular and somewhat benched with moderate slope gradients. Upslope of the road alignment a moderately steep to steep gradient slope is present. The alignment crosses over an incised stream draw at 25+825. The stream at the base of the draw has a channel that is 1-2m wide and appears to carry substantial flow during the spring freshet period. The stream draw is choked with gravel to cobble sized angular material and appears to transport significant sediment volumes during high flow events. Surficial materials consist of a blanket of gravelly sand with some silt till or morainal deposits overlain by a thin veneer of angular rubble colluvium.		2m	Well	**Moderate:** Culvert infilling due to high sediment loads on the stream. Washout of the road prism and entrainment of a portion of the material with transport to Goldslide Creek.	Sediment delivery to Goldslide Creek. **Moderate**	**Moderate**	• Cut and fill construction. • Install a 1000mm diameter culvert at 25+825 to address stream flow and sediment movement. • Excavate a large sump at the culvert inlet and clean the sump seasonally. • Armour the culvert inlets and outlets with angular rock. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: 100% in well drained morainal deposits 200% in metavolcanic bedrock Fill: 70% for fill of sidecast local material	**Low**	**Low**
								Sediment delivery to Bitter Creek. **Low**	**Low**			**V. Low**
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**		**Low**	**Low**
25+835 456337 6202321 **Sec. 2-WWW**	**25+960** 456446 6202376	30-50%	**This portion of the alignment was not reviewed on foot in the field. The risk assessment and construction recommendations are based on office interpretation of the Lidar terrain model and orthoimagery of the site.** Terrain is irregular and benched with moderate slope gradients. Orthoimagery indicates that bedrock is present at surface. Surficial materials consist of a veneer of rubble colluvium overlying bedrock.		0.5m	Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on gentle to moderate gradient terrain immediately downslope of the alignment.	**N/A**	**N/A**	• Cut and fill construction. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: 200% in metavolcanic bedrock Fill: 70% for fill of sidecast local material	**Low**	**N/A**
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**		**Low**	**Low**
25+960 456446 6202376 **Sec. 2-XXX**	**26+000** 456486 6202382	70-85% at the road location 20-40% above and below	**This portion of the alignment was not reviewed on foot in the field. The risk assessment and construction recommendations are based on office interpretation of the Lidar terrain model and orthoimagery of the site.** The alignment climbs through a small steep gradient escarpment. Terrain benches above and below the escarpment to moderate gradient slopes. The proposed road construction is expected to result in a large rock cut. Surficial materials consist of a veneer of rubble colluvium overlying bedrock.		0.5m	Well	**Moderate:** Small (<500m^3) fill slope failure due to fill placement on steep gradient slopes. Runout is expected to terminate on benched terrain 20-30m downslope.	Sediment delivery to Goldslide Creek. **Low**	**Low**	• **Full Bench Cut construction.** • Endhaul all excess material to a suitable waste site. Suitable waste sites are present in the centre of the preceding switchback at 25+670. • Scale the rock cut along the road section during and following the completion of construction activities. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: 200% in metavolcanic bedrock Fill: N/A – Endhaul all excess material.	**Low**	**V. Low**
								Sediment delivery to Bitter Creek. **Low**	**Low**			**V. Low**
							Moderate: Small scale (<1m^3) rock detachment from the large road cut along the upper leg of the switchback. Runout is expected to terminate on the proposed road alignment.	Hazard to road users or road construction workers. **Moderate**	**Moderate**		**Low**	**Low**
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers.	**High**		**Low**	**Low**

Table 6.2: Red Mountain Gold Mine Access Route Section 2 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
								Moderate				
26+000 456486 6202382 **Sec. 2-YYY**	**26+045** 456526 6202363	40-55%	**This portion of the alignment was not reviewed on foot in the field. The risk assessment and construction recommendations are based on office interpretation of the Lidar terrain model and orthoimagery of the site.** Terrain consists of a broad bowl feature with moderate to moderately steep slope gradients. Surficial materials consist of a veneer of rubble colluvium overlying bedrock.		0.5m	Well	**Moderate:** Small (<500m^3) fill slope failure due to large fill placement on moderately steep gradient slopes. Runout is expected to terminate on moderate gradient terrain within 50m downslope.	Sediment delivery to Goldslide Creek. **Low**	**Low**	• **¼ to ½ bench cut with fill composed of keyed in angular rock founded on a natural or excavated bench.** • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: 200% in metavolcanic bedrock Fill: 85% for fill of keyed in angular rock	**Low**	**Low**
								Sediment delivery to Bitter Creek. **Low**	**Low**			
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**		**Low**	**Low**
26+045 456526 6202363 **Sec. 2-ZZZ**	**26+260** 456585 6202159	40-50% at and downslope of the road 50-70% upslope of the road	**This portion of the alignment was not reviewed on foot in the field. The risk assessment and construction recommendations are based on office interpretation of the Lidar terrain model and orthoimagery of the site.** Terrain is planar to somewhat irregular with moderate to moderately steep slope gradients. Surficial materials consist of a veneer of rubble colluvium overlying bedrock.		0.5m	Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on gentle to moderate gradient terrain immediately downslope of the alignment.	**N/A**	**N/A**	• Cut and fill construction. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: 200% in metavolcanic bedrock Fill: 70% for fill of sidecast local material	**Low**	**N/A**
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**		**Low**	**Low**
26+260 456585 6202159 **Sec. 2-AAAA**	**26+345** 456543 6202086	40-60%	**This portion of the alignment was not reviewed on foot in the field. The risk assessment and construction recommendations are based on office interpretation of the Lidar terrain model and orthoimagery of the site.** Terrain is irregular with moderate to moderately steep slope gradients. Surficial materials consist of a veneer of rubble colluvium overlying bedrock.		0.5m	Well	**Moderate:** Small (<500m^3) fill slope failure due to fill placement on moderately steep gradient slopes. Runout is expected to terminate on moderate gradient terrain within 60m downslope.	Sediment delivery to Goldslide Creek. **Low**	**Low**	• **¾ Bench Cut construction with fill composed of keyed in angular rock founded on a natural or excavated bench.** • Endhaul all excess material to a suitable waste site. Suitable waste sites are present in the centre of the preceding switchback at 25+670. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: 200% in metavolcanic bedrock Fill: 85% for fill of keyed in angular rock	**Low**	**V. Low**
								Sediment delivery to Bitter Creek. **Low**	**Low**			**V. Low**
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**		**Low**	**Low**
26+345 456543 6202086 **Sec. 2-BBBB**	**26+520** 456634 6202097	20-40%	**This portion of the alignment was not reviewed on foot in the field. The risk assessment and construction recommendations are based on office interpretation of the Lidar terrain model and orthoimagery of the site.** The alignment climbs up a small bedrock controlled ridge feature via two stacked switchbacks.		0.5m	Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on gentle to moderate gradient terrain immediately downslope of the alignment.	**N/A**	**N/A**	• Cut and fill construction. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: 200% in metavolcanic bedrock	**Low**	**N/A**

Table 6.2: Red Mountain Gold Mine Access Route Section 2 – Summary of Observations, Risk Analysis, and Construction Recommendations

Road Section		Terrain Characteristics					Landslide Likelihood P(H) and Description	Elements at Risk and P(S:H)	Partial Risk P(HA)	Road Upgrade Prescription, Construction Recommendations, Design Cut and Fill Angles	Residual Hazard P(H)	Residual Partial Risk P(HA)
Start Δ	End Δ	Slope Gradient (%)	Road Prism and Terrain Characteristics	Terrain Mapping	Est. BR depth (m)	Drainage						
			Terrain is irregular with moderate slope gradients. Surficial materials consist of a veneer of rubble colluvium overlying bedrock.				**High:** Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**	Fill: 70% for fill of sidecast local material	**Low**	**Low**
26+520 456634 6202097 **Sec. 2-CCCC**	**26+930** 456784 6201895	60-90%	**This portion of the alignment was not reviewed on foot in the field. The risk assessment and construction recommendations are based on office interpretation of the Lidar terrain model and orthoimagery of the site.** The alignment traverses a section of irregular bedrock controlled terrain with moderately steep to steep slope gradients. Surficial materials consist of a veneer of rubble colluvium overlying bedrock.		0.5m	Well	**High:** Mid-sized (<1000m^3) fill slope failure due to fill placement on moderately steep to steep gradient terrain. Runout is expected to terminate on moderate gradient terrain 150-200m downslope.	Sediment delivery to Goldslide Creek. **Low**	**Moderate**	• **Full bench cut construction.** • Shift to ¾ bench cut construction in isolated locations with fill composed of keyed in angular rock where sufficient surface irregularity allows for fill placement. • Endhaul all excess material to a suitable waste site. Suitable waste sites are present in the centre of the switchback at 25+670 or on the gentle gradient area to the west of 25+540. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: 200% in metavolcanic bedrock Fill: 85% for fill of keyed in angular rock	**Low**	**V. Low**
								Sediment delivery to Bitter Creek. **Low**	**Moderate**			**V. Low**
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**		**Low**	**Low**
26+930 456784 6201895 **Sec. 2-DDDD**	**27+460** 456746 6202380	0-40%	**This portion of the alignment was not reviewed on foot in the field. The risk assessment and construction recommendations are based on office interpretation of the Lidar terrain model and orthoimagery of the site.** The alignment gains a prominent ridge feature which demarcates the height of land between the alpine bowl where Goldslide Creek is situated and the Cambria ice field to the west. Terrain is irregular with flat to moderate slope gradients on the ridge and breaks over into steep bedrock bluffs on either side of the ridge. Surficial materials consist of a veneer of rubble colluvium overlying bedrock.		0.5m	Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on gentle to moderate gradient terrain immediately downslope of the alignment.	**N/A**	**N/A**	• Cut and fill construction. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: 200% in metavolcanic bedrock Fill: 70% for fill of sidecast local material 85% for fill of keyed in angular rock	**Low**	**N/A**
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**		**Low**	**Low**
27+460 456746 6202380 **Sec. 2-EEEE**	**27+791** 456695 6202665 **POT**	0-40%	**This portion of the alignment was not reviewed on foot in the field. The risk assessment and construction recommendations are based on office interpretation of the Lidar terrain model and orthoimagery of the site.** The alignment ties into and tracks an existing road alignment. Terrain is irregular with flat to moderate slope gradients on the ridge and breaks over into steep bedrock bluffs on either side of the ridge. Surficial materials consist of a veneer of rubble colluvium overlying bedrock.		0.5m	Well	**Low:** Small (<500m^3) fill slope failure due to improper fill placement. Runout is expected to terminate on gentle to moderate gradient terrain immediately downslope of the alignment.	**N/A**	**N/A**	• Upgrade the existing alignment through conventional cut and fill methods. • If the road is intended for use during the winter season then a snow avalanche specialist must be retained to assess and control snow avalanches at the location. Cut: 200% in metavolcanic bedrock Fill: 70% for fill of sidecast local material 85% for fill of keyed in angular rock	**Low**	**N/A**
							High: Snow avalanche event impacts the alignment during the winter season.	Hazard to road users or road construction workers. **Moderate**	**High**		**Low**	**Low**